Monitoring report form for CDM project activity
(Version 07.0)

Complete this form in accordance with the instructions attached at the end of this form.

MONITORING REPORT		
Title of the project activity	Landfill Gas Recovery and Utilization at Bukit Tagar Sanitary Landfill, Hulu Selangor in Malaysia	
UNFCCC reference number of the project activity	2467	
Version number of the PDD applicable to this monitoring report	21.3	
Version number of this monitoring report	1.0	
Completion date of this monitoring report	13/01/2021	
Monitoring period number	4	
Duration of this monitoring period	01/02/2020-31/03/2020 inclusive of both days	
Monitoring report number for this monitoring period	1.0	
Project participants	KUB-Berjaya Enviro Sdn. Bhd. (KBE) ACT Commodities B.V. BP Gas Marketing Limited ACT Financial Solutions B.V. Vert Conservation Pte Ltd.	
Host Party	Malaysia	
Applied methodologies and standardized baselines	• Applied methodologies: ACM0001 – "Flaring or use of landfill gas" (Version 18.0) • Standardized baselines: Not applicable	
Sectoral scopes	13 – Waste handling and disposal	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	Not applicable	47,998 tCO_2e
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	45,010 tCO_2e	

SECTION A. Description of project activity

A.1. General description of project activity

The Bukit Tagar Sanitary Landfill (BTSL) is operated by KUB-Berjaya Enviro Sdn. Bhd. (KBE) and located in Hulu Selangor, Malaysia. The landfill receives municipal solid waste (MSW) from the country's capital, Kuala Lumpur and Selayang district in Selangor State.

The main objective for the Clean Development Mechanism (CDM) project is to avoid direct emissions of greenhouse gases (GHGs) from the landfill into the atmosphere through active extraction. The gas collected is destructed by high temperature enclosed flares as well as is used for power generation using Gas Engines with high efficiency.

Carbon emissions are reduced through two major activities:

Emission Reduction Aspects	How will emissions be reduced?
Landfill gas (LFG) Extraction and Destruction (Methane (CH_4) avoidance)	Instead of releasing LFG (consisting CH_4) to the atmosphere, the gas will be collected and destroyed in enclosed flares and Gas Engines
Power Generation (Fuel replacement)	Less carbon dioxide (CO_2) will be emitted by replacing electricity generated from grid power with electricity produced from LFG (considered as renewable)

LFG extraction from Phase 1, Phase 2, and Phase 3 Cells has continued to operate during this monitoring period.

One (1) high temperature enclosed flare with a maximum capacity of 2,500 Nm^3/hr is in operation while the remaining portion of the gas captured was sent to a unit of 1.2MW Gas Engine (Gas Engine No.1), two (2) units of 1.56MW Gas Engines (Gas Engine No.2 and No.3) and three (3) units of 2MW Gas Engine (Gas Engine No.4, No. 5 and No. 6) to generate electricity. The electricity produced by the gas engines is exported to the grid.

The 4th monitoring period of 2nd crediting period is from 01/02/2020 to 31/03/2020 (inclusive of both days). The total emission reductions achieved during this monitoring period is 47,998 tCO_2e.

A.2. Location of project activity

Information	Description
Host Party(ies)	Malaysia
Region/ State/ Province, etc.	State of Selangor
City/ Town/ Community, etc.	Mukim Sg. Tinggi, District of Hulu Selangor The project location is situated approximately 5km to the west of the Bukit Tagar Interchange along the North-South Expressway and 40km from central Kuala Lumpur. The landfill is easily accessible via expressway and a dedicated Bukit Tagar Interchange has been developed for access from the North-South Expressway. The landfill is situated in a leased agricultural land, surrounded by hectares of oil palm plantations and rubber trees.
Physical/ Geographical location	Latitude / Longitude / Description: 3°30'168" / 101°28'428" / North 3°29'07" / 101°28'452" / South 3°29'46" / 101°28'20" / West 3°29'69" / 101°29'268" / East

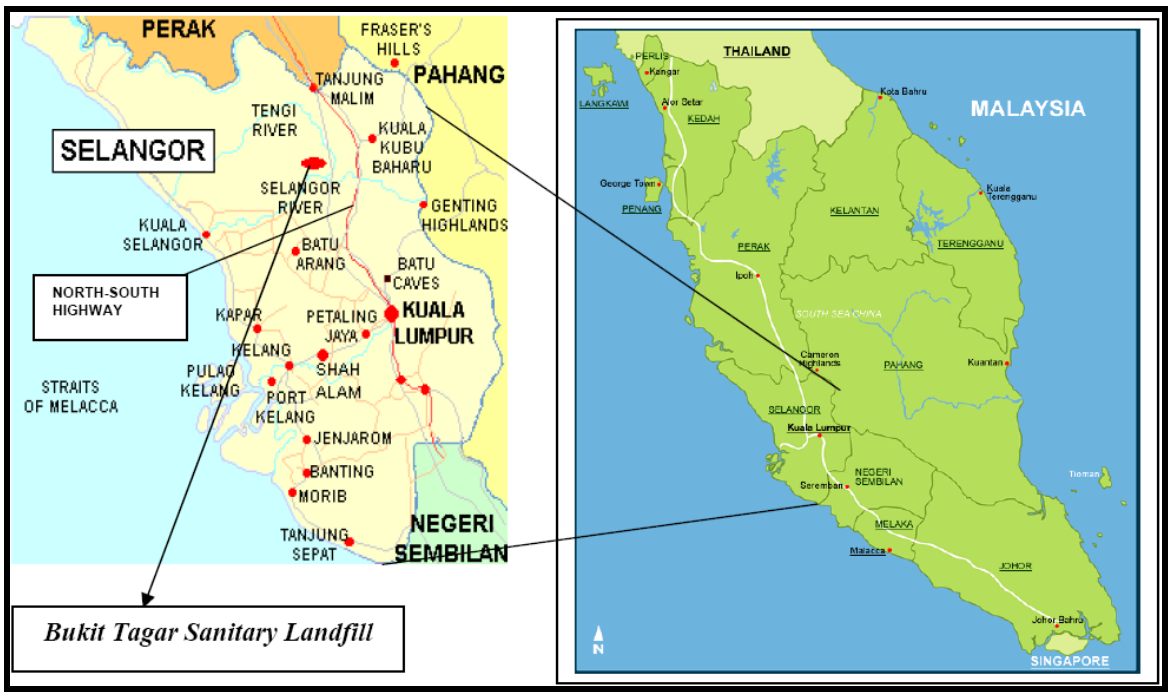


Figure 1: Location of BTSL and Selangor State

A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Malaysia (Host Party)	KUB-Berjaya Enviro Sdn. Bhd. (KBE) (Private)	No
Netherlands	ACT Commodities B.V.	No
United Kingdom of Great Britain and Northern Ireland	BP Gas Marketing Limited	No
Switzerland	ACT Financial Solutions B.V.	No
Sweden	Vert Conservation Pte Ltd.	No

Note: ACT Commodities B.V. and BP Gas Marketing Limited are valid as of 31/12/2020), ACT Financial Solutions B.V. and Vert Conservation Pte Ltd. are involved starting from 18/09/2020, and 11/11/2020 respectively.
https://cdm.unfccc.int/Projects/DB/DNV-CUK1238680609.1/view?cp=1

A.4. References to applied methodologies and standardized baselines

The project has applied the following approved methodology and tools:

Approved Methodology:

ACM0001: “Flaring or use of landfill gas – Version 18.0”

Methodological Tools referred to include:

- “Emissions from solid waste disposal sites” (*Version 07.0*);
- “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (*Version 02.0*);
- “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion” (*Version 02*)
- “Project emissions from flaring” (*Version 02.0.0*);
- “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (*Version 03.0*); and
- “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period” (*Version 03.0.1*).

A.5. Crediting period type and duration

Date of Registration	28/08/2009
Type of Crediting Period	Renewable (7 Years)
1st Crediting Period	28/08/2009 – 27/08/2016 (Both dates inclusive)
2nd Crediting Period	28/08/2016 – 27/08/2023 (Both dates inclusive)

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

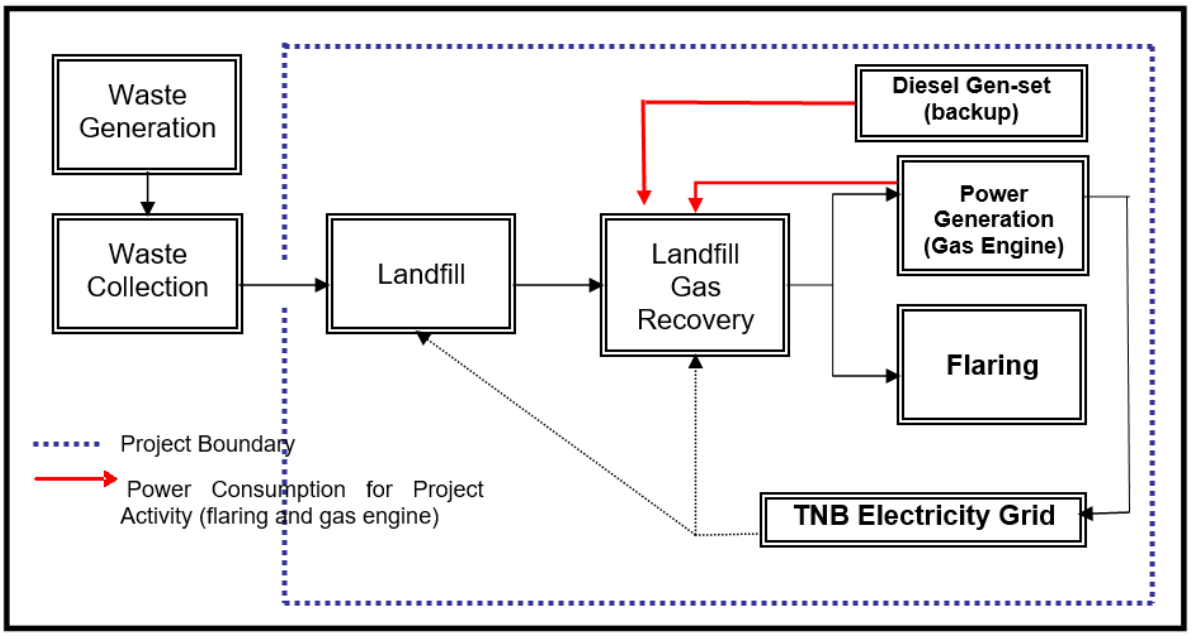
The landfill is being developed in phases. The detailed information on the phases is presented below:

Cell	Status of Filling	Duration of Filling	Amount of Waste Disposed (t)
Advance Cell	Closed	Apr 2005 – Nov 2007	1,429,323.47
Phase 1	Closed	Nov 2007 – Dec 2011	3,730,406.57
Phase 2	Closed	Aug 2010 – Dec 2017	6,243,457.40
Phase 3	Operation	Jan 2018 - On-going	2,276,969.58 (Latest March 2020)

Relevant dates for the project activities tabulated below:

Bukit Tagar Project	Construction Start Date	Date of Commission	Operation Status
Second flaring system (Flare No.2)	22/01/2010	07/08/2010	Operating
Gas Engine No.1	03/01/2011 (Delivery to the site)	01/06/2011	Operating
Gas Engine No.2	06/08/2012 (Signed-off Delivery Order)	06/12/2013[3]	Operating
Gas Engine No.3	06/08/2012 (Signed-off Delivery Order)	06/12/2013[4]	Operating
Gas Engine No.4	26/12/2014 (Signed-off Delivery Order)	26/10/2015[5]	Operating
Gas Engine No.5 & 6	05/03/2018 (Signed-off Delivery Order)	10/05/2019[6]	Operating

The landfill gas recovery, flaring, and power generation system can be illustrated below:



Note: Diesel generator which will be used as a backup for project activities during the power failure of the grid is added into the chart

Figure 2: **Overall LFG Recovery, Flaring and Power Generation Design**

Description of the installed technologies

The technology applied and transferred into this project has been implemented and proven in Europe (Denmark and Germany) as well as in China (extraction and flaring system).

The detailed technical description is further described below:

Gas Extraction System in Advance Cell

Q2 Engineering Sdn. Bhd., a subsidiary of Q2 A/S of Denmark was appointed as the turnkey contractor to construct the gas extraction and flaring system for Advance Cell. 42 vertical gas extraction pipes were installed in the landfill to extract the LFG. These wells were connected to 8 units of main gas collection pipes that led to the LFG flaring system.

Figure 3: An Example of Vertical Well Installed in Advance Cell

These vertical wells can be individually regulated and controlled. The advanced cell has stopped operation and caped in this monitoring period.

Gas Extraction System in Phase 1 Cell

Stage 1 of Phase 1 Cell was completed in August 2010 and closed in December 2011. The gas extraction from the phase 1 cell continued during this monitoring period. The design of the gas extraction wells is based on a series of horizontal gas extraction wells constructed over the entire Phase 1 Cell.

Figure 4: Horizontal Gas Extraction Wells in Phase 1 Cell

High-Temperature Enclosed Flaring System (Flare No.2)

The high-temperature enclosed flaring system was installed to cater for the extra LFG extracted from Phase 1 and 2 Cell. The flare system included a containerised blower and flaring system with a maximum capacity to flare off 2,500 Nm^3/hr LFG.

Figure 5: High-Temperature Enclosed Flares

Details of Flare No. 2 specifications are listed below:

Specifications	Details
Manufacturer	Fairyland Environmental Technology, China
Gas flow	Maximum – 2,500 Nm^3/hr
Retention time	>0.3 seconds at 800-1,000^oC
Gas blower	Twin-lobe roots blower
Gas analysers	Gas analysers for CH_4 and O_2

Gas Extraction System in Phase 2 Cell

Phase 2 Cell was completed in July 2010. 12 lines of horizontal wells with gas pipelines were installed in the landfill to extract the LFG. The cell stopped receiving waste started in December 2017. The design of the gas extraction wells is based on a series of horizontal gas extraction wells constructed over the cell.

Gas Extraction System in Phase 3 Cell

Phase 3 Cell was completed in Dec 2017. 28 lines of horizontal wells with gas pipelines were installed in the landfill to extract the LFG. Phase 3 cell still in operation during this monitoring period, the expected end of life span for phase 3 cell is December 2023.

Gas Analyser and Data Logging

Monitoring of the correct functioning of the flare system was provided by a continuous-logging system which examines the operational parameters of the flare. The gas analyzing system is multi-functional environmental monitoring equipment that can monitor up to 14 different measurements and data logging channels. Data from the logging system was presented on a local screen (on-line data) and stored in a local personal computer (PC) unit with external communication via the Global System for Mobile Communications (GSM).

Data were downloaded directly from the built-in data logger to a PC and were also transmitted to an external server and PC as a back-up.

Gas Engine Energy Power Plants

A high-efficiency (electrical efficiency > 42%) Gas Engine (net dispatch of 1 MW) was chosen for the generation of electricity from LFG.

Figure 6: Gas Engine 2 & 3

To ensure that good quality LFG arrives at Gas Engine No.1, LFG pre-treatment system comprising of a chiller (made in Germany) and activated carbon filter was also set up to remove moisture and impurities such as hydrogen sulphide (H_2S) and siloxanes before Gas Engines. A landfill gas blower was installed to ensure that the required gas pressure for Gas Engines are maintained. With the additional gas extraction of LFG in Phase 2, two (2) units of 1.56 MW gas engines were delivered to the site on 06/08/2012. The gas engines were commissioned on 06/12/2013. In addition to the new gas engine installation, an additional pipeline equipped with skid-mounted LFG gas blower was installed in September 2012.

An additional 2MW gas engine was delivered to the site on 18/09/2015. The gas engine was commissioned on 26/10/2015. Two (2) units of 2MW Gas Engine (Gas Engine No. 5 and No. 6) were also delivered to site on the 05/03/2018. The gas engine was commissioned on 10/05/2019 to generate electricity. The details of specification for Gas Engines are tabulated below:

Specifications	**Gas Engines**			
	No.1	**No.2 & 3**	**No.4**	No.5 & 6
Manufacturer (Origin)	MWM (Germany)	MWM (Germany)	MTU	MWM (Germany)
Model	TCG 2020 V12	TCG 2020 V16	GB1948B5	TCG 2020 V20
Electric power output (net to grid)	1 MW (total max. gross output 1.2 MW)	1.56 MW	2 MW	2 MW
Voltage	11 kV	415 V	11000V	11kV
Frequency	50 Hz	50 Hz	50 Hz	50 Hz
Minimum heating value (LHV)	5.9 kWh/m^3	5.0 kWh/m^3	5.0 kWh/m^3	5.0 kWh/m^3

Centralised SCADA System

The Centralized (Supervisory Control and Data Acquisition) SCADA Interface was developed to integrate all existing SCADA or operation monitor systems, ranging from individual Flare to Gas Engines. The objective of the integrated monitoring system is aimed to improve the efficiency of staff movement, monitoring process, and data collection as well as serving as additional storage of the database. The new system offered a remote monitoring option which allows access through internet connection for view-only if provided with the correct authentication key.

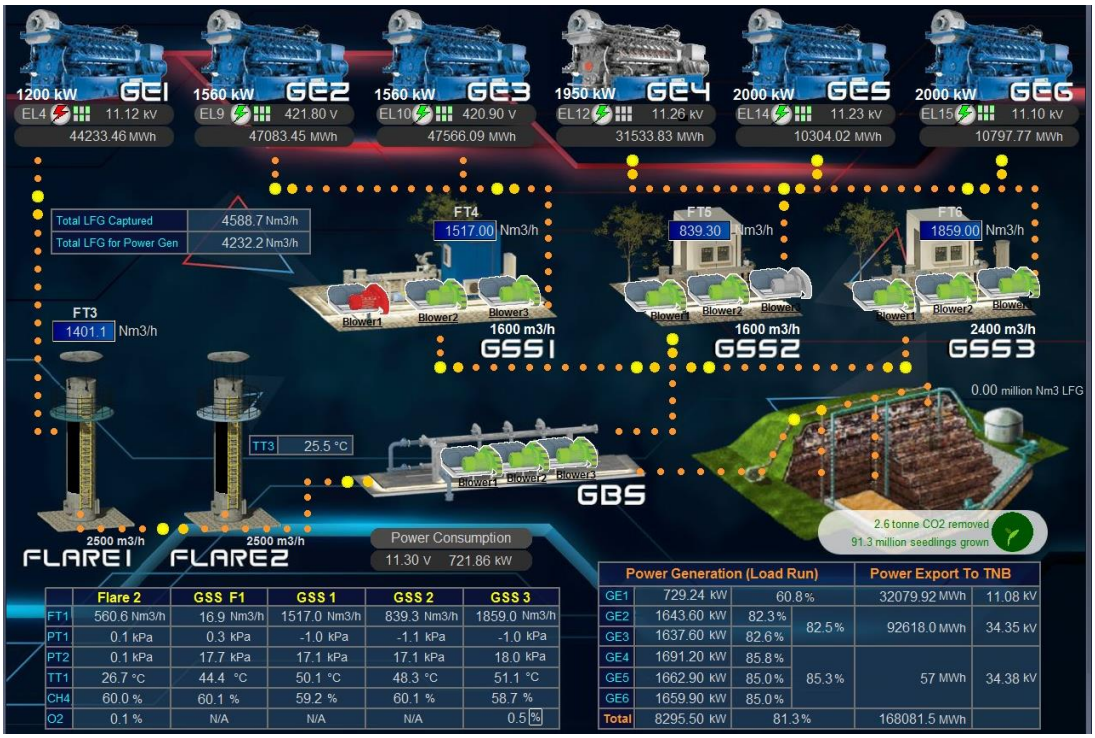


Figure 7: Centralized SCADA Interface

Implementation status of project activity

For the reporting period of 01/02/2020 to 31/03/2020, the key CDM activities implemented are described below:

Gas Extraction System in Phase 1, 2, and 3 Cells and Flare No.2

The flaring system in Phase 1 Cell was completed during the 2nd monitoring period and started its operation on 07/08/2010. The LFG extracted from Phase 1, 2, and 3 Cells is transferred via a transfer pipe and fed to Flare No.2.

The total running time for Flare No.2 is 11% in this monitoring period. The shutdown of Flare No. 2 is mainly due to most of the gas is supplied to gas engines instead of the flare.

The details on the downtime of the system (over the monitoring period covered by this report) are presented in **Appendix 1**.

Power Generation

During this monitoring period, the power generated from Gas Engine No.1, No.2, and No.3 continued to be uploaded to the grid.

Gas Engine No.4 was commissioned on 26/10/2015, on the other hand, Gas Engine No.5 and No.6 were commissioned on 10/05/2019. The supply of landfill gas for Gas Engines comes from an independent piping system to GSSF1 (Gas Engine No.1), GSS1 (Gas Engine No.2 and No.3), GSS2 (Gas Engine No. 4). and GSS3 (Gas Engine No. 5 and No.6).

The properties of the landfill gas are monitored by independent monitoring equipment, i.e. temperature, pressure, methane content, and flow rate for GSS1, GSS2, GSS3, and GSSF1. The power generated from the gas engines is uploaded to the grid.

The total running time for Gas Engines in this monitoring period is tabulated as below:

No	Description	Total Running Time (%)
1	Gas Engine No. 1	99%
2	Gas Engine No. 2	87%
3	Gas Engine No. 3	94%
4	Gas Engine No. 4	0%
5	Gas Engine No. 5	70%
6	Gas Engine No. 6	66%

The shutdown of GEs mainly due to the service and maintenance for all the engines and major overhaul for GE No. 4.

The details on the downtime of Gas Engine No.1, No.2, No.3, No.4, No.5, and No.6 are presented in **Appendix 2**.

B.2. Post-registration changes

B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies, standardized baselines or other methodological regulatory documents

No temporary deviations have been applied during this monitoring period.

B.2.2. Corrections

No corrections during this monitoring period.

B.2.3. Changes to the start date of the crediting period

No changes to the start date of the crediting period during this monitoring period.

B.2.4. Inclusion of monitoring plan

No inclusion of a monitoring plan to the registered PDD that was not included at registration.

B.2.5. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

During the 3rd monitoring period of 2nd crediting period, KBE has decided to increase the power generation from 5.5MW to 9.5MW with the addition of two (2) gas engines with an installed capacity of 2MW each. A revision of the monitoring plan was requested and approved on 12/06/2020 (PRC-2467-006).

B.2.6. Changes to project design

During the 3rd monitoring period of 2nd crediting period, KBE has decided to increase the power generation from 5.5MW to 9.5MW with the addition of two (2) gas engines with an installed capacity of 2MW. A design change was requested and approved on 12/06/2020 (PRC-2467-006).

B.2.7. Changes specific to afforestation or reforestation project activity

Not applicable to this project activity.

SECTION C. Description of monitoring system

Monitoring Methodology

The basis of the monitoring plan (MP) was formulated based on the approved methodology ACM0001 – *Flaring or use of landfill gas (Version 18.0).*

Tool to determine the mass flow of a greenhouse gas in a gaseous stream

The MP referred to the *Tool to determine the mass flow of a greenhouse gas in a gaseous stream*. Referring to the tools, for LFG temperatures below 60ºC, moisture could be neglected due to its very low influence on final results and thus, the measurement in wet or dry basis are not important (as reflected in the amendments to ACM0001, version 9.1 onwards). In the case where the LFG temperature exceeds 60ºC, the same basis for both CH_4 concentration and flow measurement will be considered according to the tools.

The detailed description of the calculation applied to the CER Calculation Sheet is as shown in **Appendix 3**.

Transmission and Distribution Losses (TDL_y)

According to page 65 of the registered PDD, version 21.3, the Transmission and Distribution Losses ($TDL_{k,y}$) value applied in this project is 7.74% from 2017 onwards. This value was reported in the Tenaga Nasional Berhad (TNB)[1] Annual Report 2016[2].

Operation and Management Structure for Monitoring

The organization structure for the Bukit Tagar CDM monitoring team is shown below:

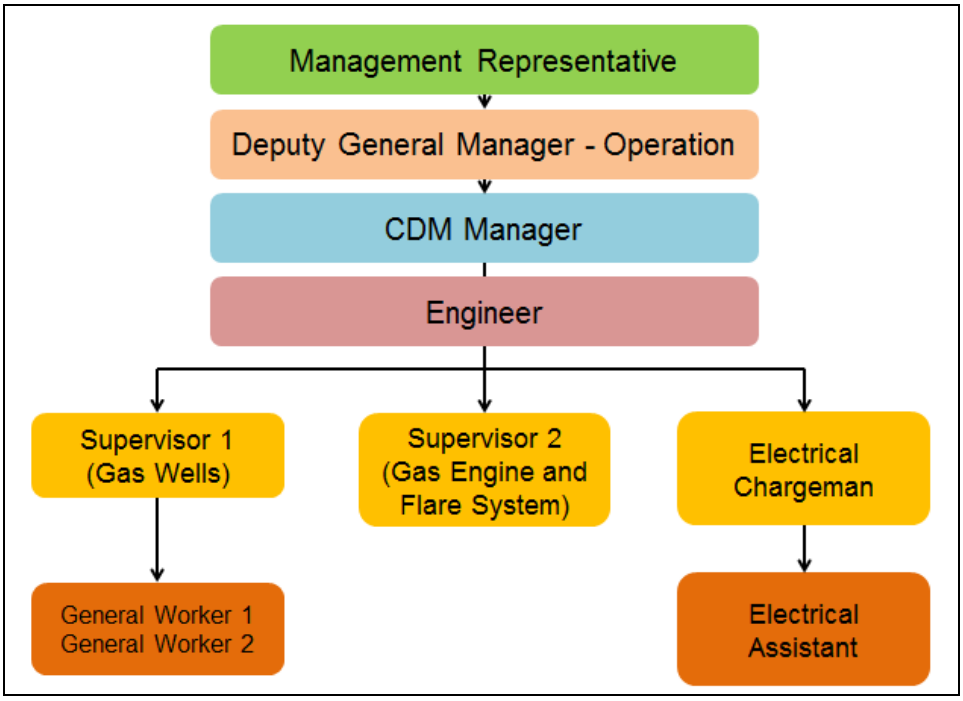


Figure 8: Organisational Structure for CDM Monitoring for BTSL LFG Recovery and Utilisation Project

[1] Tenaga Nasional Berhad is the largest electricity provider in Malaysia and is responsible for the grid transmission and distribution in Peninsular Malaysia.
[2] https://www.tnb.com.my/assets/annual_report/TNB_Annual_Report_2016.pdf

The roles and responsibilities of the monitoring team in carrying out the MP are detailed as follow:

Table 1: Responsibilities of the CDM Monitoring Team

Role	Responsibility in CDM monitoring
Management Representative	• Reports to and obtain decisions from management on CDM-related matters • Chairs internal meetings on CDM matters • Signs off official correspondence for external parties
Deputy General Manager - Operation	• Reports to the management representative (MR) • Oversees entire operation of landfills (including LFG management system) • Covers responsibility of CDM Manager when he is not available
CDM Manager	• Reports to the Deputy General Manager - Operation • Oversees and coordinates the entire CDM monitoring plan • Verifies and signs off all relevant monitoring records • Ensures Quality Control / Quality Assurance (QC/QA) is carried out • Ensures all data are recorded and necessary documentations are prepared according to the requirements of CDM monitoring • Responsible in optimising the LFG extraction and utilisation system
Engineer	• Reports to the CDM Manager • Assists the CDM Manager in performing CDM monitoring works • To monitor daily operation for landfill gas operations • To assist in daily monitoring records for all CDM related equipment • To prepare daily summary record for landfill gas operation
CDM Consultant	• Provides advice on all CDM-related matters • Prepares monitoring reports for verifications • Liaises with the verifier on verification process • Conducts regular audits on CDM monitoring
Supervisors	• Report to the CDM Manager on CDM monitoring issues • Check and ensure that the flaring system is functional • Ensure all data recording devices are functioning and calibrated as planned (including performing QA/QC) • Check and sign the daily monitoring log sheets for CDM monitoring • Supervise general workers in maintenance work and record monitored parameters for CDM monitoring • Identify maintenance requirement and contact the supplier if maintenance and support are needed • Optimise the flare operation together with the CDM Manager • Responsible with the security of locked Programmable Logic Controller (PLC) control room. The supervisor will hold the door key for the PLC control room
General Workers	• Perform regular operational and maintenance tasks • Record necessary readings in daily monitoring log sheets and request verification from the supervisors on the log sheets • Report any fault to supervisor-in-charge or the electrical chargeman

The team is overall headed by the MR who oversees the entire CDM monitoring implementation. The MR receives direct updates and support from the site staff headed by the Deputy General Manager - Operation. The Deputy General Manager – Operation is supported by the CDM Manager who is the key coordinator to all CDM monitoring matters on-site. The CDM Manager is assisted by an engineer, a group of technicians and workers who will perform the daily recording and checking tasks.

The CDM Consultant (Eco-Ideal Consulting Sdn. Bhd.) was appointed to assist KBE in ensuring that the monitoring plan and requirements were done according to the MP. The consultant played the role of a trainer and conducted independent audits as part of the QA/QC procedures set up for this project.

Relevant Monitoring Points

The parameters monitored during the monitoring period are illustrated in the following figure:

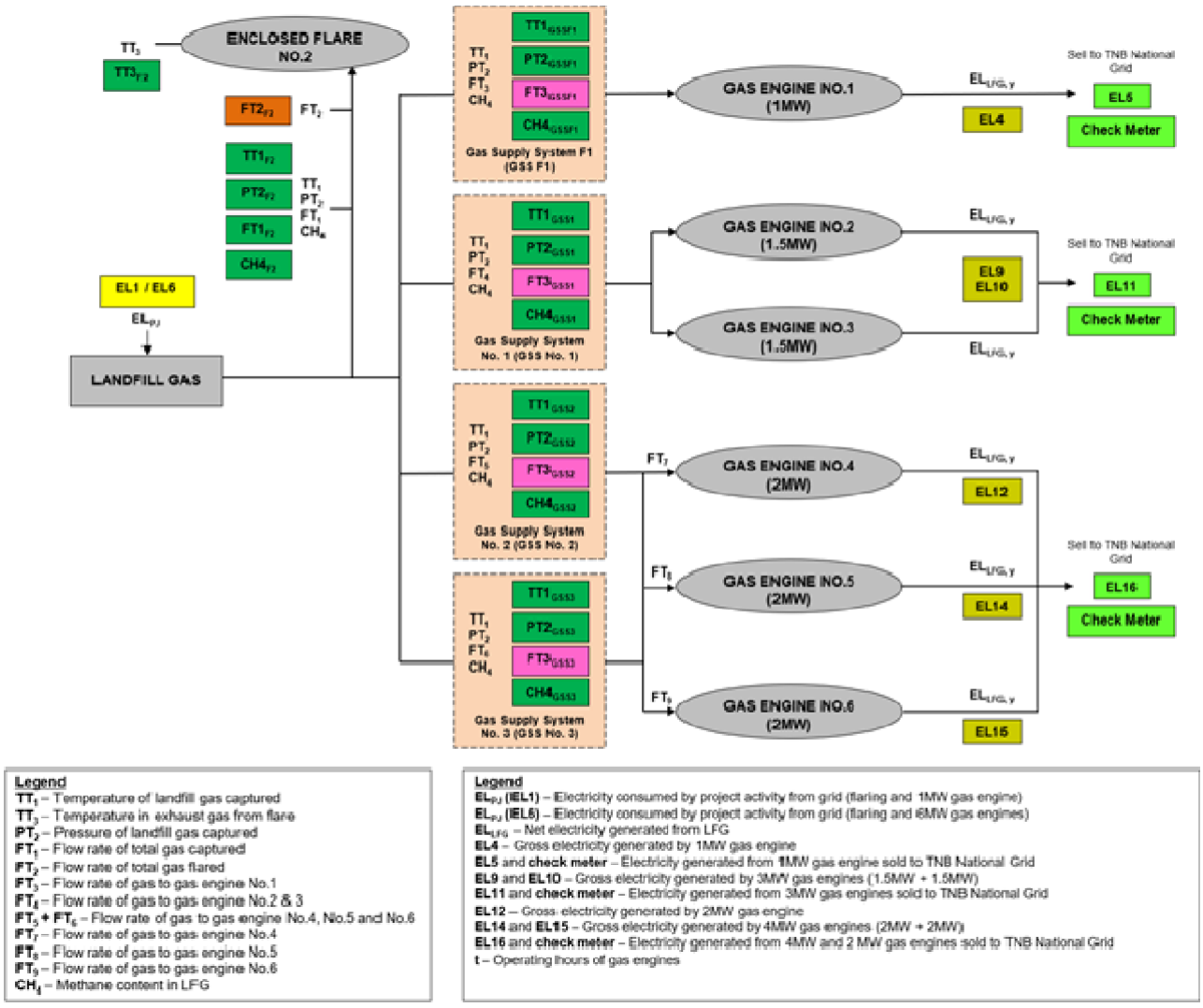


Figure 9: Key Parameters Monitored under the CDM Monitoring Plan

Landfill gas will be captured and send to Enclosed Flare No.2, Gas Supply System F1 (GSS F1), Gas Supply System No.1 (GSS No.1), Gas Supply System No.2 (GSS No.2), and Gas Supply System No.3 (GSS No.3). The flow rate of total gas flared by Enclosed Flare No.2 is monitored by FT2 while the flow rate of gas to gas engines are monitored by FT3 (GSS F1), FT4 (GSS No.1) and FT5 (GSS No.2), FT6 (GSS No.3) respectively. Each gas engines also have their meter to record the flow supply from GSS, where FT7 for gas engine no.4, FT8 is for gas engine no.5, FT9 is for gas engine no.6 respectively.

The gross electricity generated by each gas engine is monitored using EL4, EL9, EL10 and EL12, EL14, and EL15. The amount will be compared with EL5, EL11, and EL16 which are managed by Tenaga National Berhad to obtain the lower amount so that the result is conservative. As data will be captured separately in the flaring and power generation system (Flare No.2, Gas Engine No.1, and so forth), a specific subscript will be assigned to the monitoring parameters of the different equipment installed.

Relevant regulations on LFG project activities shall be monitored and updated upon renewal of each crediting period. Changes to regulations, if any will be converted to the amount of methane in the LFG which is flared in the baseline due to a requirement in year y ($F_{CH4,BL,R,y}$).

Data Recording and Documentation

All relevant data/measurements of the parameters taken were recorded and kept in an appropriate format and archived after the crediting period to ensure that the data are accessible especially during the monitoring and verification process of the project.

Data were recorded in the following way:

Continuous Monitoring – Data in Softcopy:
Data logger (automatic recording in the computer)

Manual Recording – Data in Hardcopy:
Daily monitoring log sheets and record books (manual recording)

Based on the MP, key parameters (temperature, pressure, the flow of gas, CH_4 concentration in biogas) were continuously monitored and recorded via the data logger at the control room.

As a back-up data recording system, the on-site workers were required to manually record certain monitored parameters in daily monitoring log sheets. These records were filed and kept in the office which can be accessible by the CDM Manager and technicians whenever necessary. These log sheets (in hard copies) were scanned for electronic filing every month.

A summary of the data directly monitored is tabulated below:

Table 2: CDM Monitoring Parameters, Frequency and Archiving

Parameter	CDM ID	Equipment ID	Monitoring equipment	Recording frequency	Documentations	Data archive
Temperature	T_t ($T_{TT1,F2}$) T_t ($T_{TT1,GSS1}$) T_t ($T_{TT1,GSS2}$) T_t ($T_{TT1,GSS3}$) T_t ($T_{TT1,GSSF1}$)	$TT_{1,Flare}$ No.2/GSS1/GSS2/GSS3/GSSF1	Thermocouple	Every 1 min (auto) Daily (manual) – as back-up	Softcopy Hardcopy	(.MDB MS Access database) Daily log sheet will be scanned into PDF format for archiving
Flare Temperature	$T_{EG,m}$ ($T_{Flare,F2}$)	$TT_{3,Flare}$ Flare No.2	Thermocouple	Every 1 min (auto) Daily (manual) – as back-up	Softcopy Hardcopy	(.MDB MS Access database) Daily log sheet will be scanned into PDF format for archiving

Parameter	CDM ID	Equipment ID	Monitoring equipment	Recording frequency	Documentations	Data archive
Pressure	P_t ($P_{PT2,F2}$) P_t ($P_{PT2,GSS1}$) P_t ($P_{PT2,GSS2}$) P_t ($P_{PT2,GSS3}$) P_t ($P_{PT2,GSSF1}$)	$PT_{2,Flare\ No.2/GSS1/GSS2/GSS3/GSSF1}$	Pressure Gauge	Every 1 min (auto) Daily (manual) – as back-up	Softcopy Hardcopy	(.MDB MS Access database) Daily log sheet will be scanned into PDF format for archiving
Flowrate	$V_{t,wb}$ ($LFG_{total,\ Flare\ No.2,y}$) $V_{t,wb}$ ($LFG_{flare,\ Flare\ No.2,y}$) $V_{t,wb}$ ($LFG_{electricity,GSS,y}$)	$FT_{1,Flare\ No.2}$ $FT_{2,\ Flare\ No.2}$ $FT_{3,GSS1/GSS2/GSS3/GSS\ F1}$	V-Cone Differential Pressure Flowmeter	Every 1 min (auto) Daily (manual) – as back-up	Softcopy Hardcopy	(.MDB MS Access database) Daily log sheet will be scanned into PDF format for archiving
Methane Fraction	$V_{CH4,m,db}$ ($W_{CH4,Flare\ No.2/GSS,y}$)	$CH_{4,Flare\ No.2/GSS1/GSS2/GSS3/GSS\ F1}$	Continuous Infrared Gas Analyser	Every 1 min (auto) Daily (manual) – as back-up	Softcopy Hardcopy	(.MDB MS Access database) Daily log sheet will be scanned into PDF format for archiving
Electricity consumed by the project	$EG_{PJ,y}$ ($EL_{PJ,y}$)	EL_{PJ} (EL1, EL6)	kWh meter	Daily (manual)	Softcopy (scanned copy) Hardcopy	Data recorded will be compiled into MS Excel and aggregated for monthly amount Daily log sheet will be scanned for archiving
Electricity generated by LFG	$EG_{PJ,y}$ ($EL_{LFG,GE\ No.1,y}$) $EG_{PJ,y}$ ($EL_{LFG,GE\ No.2,y}$) $EG_{PJ,y}$ ($EL_{LFG,GE\ No.3,y}$) $EG_{PJ,y}$ ($EL_{LFG,GE\ No.4,y}$) $EG_{PJ,y}$ ($EL_{LFG,GE\ No.5,y}$) $EG_{PJ,y}$	$EL_{LFG,GE\ No.1}$ (EL4) $EL_{LFG,GE\ No.2}$ (EL9) $EL_{LFG,GE\ No.3}$ (EL10) $EL_{LFG,GE\ No.4}$ (EL12) $EL_{LFG,GE\ No.5}$ (EL14) $EL_{LFG,GE\ No.6}$	kWh meter	Daily (manual)	Softcopy (scanned copy) Hardcopy	Data recorded will be compiled into MS Excel and aggregated for monthly amount Daily log sheet will be scanned for archiving

Parameter	CDM ID	Equipment ID	Monitoring equipment	Recording frequency	Documentations	Data archive
	($EL_{LFG,GE\ No.6,y}$)	(EL15)				
	$EG_{PJ,y}$ ($EL_{LFG,y}$)	EL_{LFG} (EL5, EL11, and EL16 TNB main energy meters) TNB check energy meters	kWh meter	Daily (manual)	Softcopy (scanned copy) Hardcopy	TNB joint meter reading certificate will be scanned for archiving

NOTE:

Data recorded by the flow meters were normalised to Nm^3 with the temperature and pressure monitored automatically via the software. Thus, there was no need to normalise the recorded flow further.

Monitoring Equipment and Equipment Calibration

The list of CDM monitoring equipment used is shown in Table 3 below.

Table 3: List of CDM Monitoring Equipment and *Calibration* for Flare No.2

No	Item	Parameters	Equipment ID	CDM Monitoring ID	Unit	Manufacturer	Model No.	Serial No.	Accuracy	Range	Last Calibration Date & Cert No.	Recommended Next Calibration Date	Recommended Frequency of Calibration
Flare System													
1	Temperature Transmitter	Temperature (T)	$TT_{1,Flare\ No.2}$	T_t ($T_{TT1,F2}$)	^0C	Honeywell	STT25M-0-EN0-000-000-000-00-3D	B839917437	±0.5% of span	0-100°C	18/09/2019 & CTT 3709-19 (01/02/2020 - 31/03/2020)	17/09/2020	Annually
2	Temperature Transmitter	Flare Temperature ($T_{flare,y}$)	$TT_{3,Flare\ No.2}$	$T_{EG,m}$ ($T_{Flare,F2}$)	^0C	Honeywell	STT25M-0-EN0-000-000-000-00-3D	B838901937	±0.5% of span	0-1200°C	18/09/2019 & CTT 3710 -19 (01/02/2020 - 31/03/2020)	17/09/2020	Annually
3	Pressure Sensor	Pressure Transmitter (P)	$PT_{2,Flare\ No.2}$	P_t ($P_{PT2,F2}$)	kPa	Rosemount	3051TG1A2B21AB4K5M5	5916057	±0.1%	0-40 kpa	18/09/2019 & CTP 5856-19 (01/02/2020 - 31/03/2020)	17/09/2020	Annually
4	Flow Meter	Total Biogas Flow Rate ($LFG_{total,y}$)	$FT_{1,Flare\ No.2}$	$V_{t,wb}$ ($LFG_{total,Flare\ No.2,y}$)	NM^3/hr	Flow transmitter – Rosemount Differential Pressure Transmitter – Kingways Control Vcone	3051CD1A22A1AM5B4K5	4972946 / FT119 (8102101)	±1%	3-5000Nm^3/h	04/06/2018 & CTP 3706 - 18 (01/02/2020 - 31/03/2020)	03/06/2020	24 months
5	Flow Meter	Flaring Biogas Flow Rate ($LFG_{flare,y}$)	$FT_{2,Flare\ No.2}$	$V_{t,wb}$ ($LFG_{flare,Flare\ No.2,y}$)	NM^3/hr	Flow transmitter – Rosemount Differential Pressure Transmitter – Kingways Control Vcone	3051CD1A22A1AM5K5Q4	5476627 / FT140 (10031701)	±0.5%	3-5000Nm^3/h	04/06/2018 & CTP3705 - 18 (01/02/2020 - 31/03/2020)	03/06/2020	24 months
Gas Analysers													
6	CH_4 Meter	Methane fraction of LFG	$CH_{4,Flare\ No.2}$	$V_{CH4,m,db}$ ($W_{CH4,Flare\ No.2,y}$)	%	Guardian Plus	97460	33542	±2% of full scale	0-100%	18/09/2019 & CTM 1609-19 (01/02/2020 - 31/03/2020)	17/09/2020	Annually

Table 4: List of CDM Monitoring Equipment and Calibration for GSS1 (GE No. 2 and GE No. 3)

No	Item	Parameters	Equipment ID	CDM Monitoring ID	Unit	Manufacturer	Model No.	Serial No.	Accuracy	Range	Last Calibration Date & Cert No.	Recommended Next Calibration Date	Recommended Frequency of Calibration
Gas Supply System													
1	Temperature Transmitter	Temperature (T)	$TT_{1,GSS1}$	T_t ($T_{TT1,GSS1}$)	^0C	Honeywell	STT25M-0-ENS-000-000-000-00-3H	B527143837	±1%	0-100°C	18/09/2019 & CTT 3711-19 (01/02/2020 - 31/03/2020)	17/09/2020	Annually
2	Pressure Sensor	Pressure Transmitter (P)	$PT_{2,GSS1}$	P_t ($P_{PT2,GSS1}$)	kPa	Rosemount	3051TG1A2B21AB4E5Q4	5584784	±0.25%	0-40 kpa	11/10/2018 & CTP 5488-18 (01/02/2020 - 20/02/2020)	10/10/2019	Annually
											21/02/2020 & CTP 2282-20 (21/02/2020 - 31/03/2020)	20/02/2021	Annually
3	Flow Meter	Flow Rate of Total Gas to Energy ($LFG_{electricity,y}$)	$FT_{3,GSS1}$	$V_{t, wb}$ ($LFG_{electricity,GSS1,y}$)	NM^3/hr	Rosemount	3051 CD1A22A1AM5B4DFK5	5988022	±0.5%	200-2,000 Nm^3/h	11/10/2018 & CTP 5490-18 (01/02/2020 - 31/03/2020)	10/10/2020	24 months
4	CH_4 Meter	Methane fraction of LFG	$CH_{4,GSS1}$	$V_{CH4,m,db}$ ($W_{CH4,GSS1,y}$)	%	Guardian Plus	97460	33436	±2% of full scale	0-100%	26/07/2019 & AL-E/0198-0719 (01/02/2020 - 31/03/2020)	25/07/2020	Annually
Power Generation and Electricity Consumption													
5	Power meter	Grid for project activity	EL_{PJ} (EL6)	$EG_{EC,y}$ ($EL_{PJ,y}$)	kWh	IME	NEMO 96HD+	2661930098	Class 0.5S	0-250/5A	25/01/2018 &SP/RA/2018/065/002 (01/02/2020 - 31/03/2020)	24/01/2021	36 months
6	Power meter	Gross generation from GE No.2	$EL_{LFG,GE\ No.2}$ (EL9)	$EG_{PJ,y}$ ($EL_{LFG,GE\ No.2,y}$)	kWh	EDMI Limited	MK6G Genius 2000-0601-140-N-G-240	211516862	Class 0.5S	99999999.99kWh	25/01/2018 & SP/RA/2018/065/003 (01/02/2020 - 31/03/2020)	24/01/2020	24 months
7	Power meter	Gross generation from GE No.3	$EL_{LFG,GE\ No.3}$ (EL10)	$EG_{PJ,y}$ ($EL_{LFG,GE\ No.3,y}$)	kWh	EDMI Limited	MK6G Genius 2000-0601-140-N-G-240	211516863	Class 0.5S	99999999.99kWh	25/01/2018 & SP/RA/2018/065/004 (01/02/2020 - 31/03/2020)	24/01/2020	24 months
8	Power meter	Electricity sold to grid (MWh) - recorded by grid operator	EL_{LFG} (EL11)	$EG_{PJ,y}$ ($EL_{LFG,y}$)	kWh	EDMI Limited	Mk6E	908705152	Class 0.5S	99,999,999kWh	06/12/2009 & TNBM/PJ/09/076 (01/02/2020 - 31/03/2020)	05/12/2014	5 years
9	Power meter	Electricity sell to grid (MWh) - check energy meter recorded by grid operator	-	-	kWh	EDMI Limited	Mk6E	908705154	Class 0.5S	99,999,999kWh	06/12/2009 & TNBM/PJ/09/076 (01/02/2020 - 31/03/2020)	05/12/2014	5 years

During this monitoring period, maximum permission error are applied for the equipment which has an delay calibration as conservative approach is as listed below:

1. PT2 - due to delay in calibration, the maximum permissible error of ±0.25% which is the equipment accuracy error was applied to PT2 from 01/02/2020 – 20/02/2020 as a conservative approach.
2. EL9 - Due to delay calibration, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to EL9 from 01/02/2020 - 31/03/2020as a conservative approach.
3. EL10 - Due to delay calibration, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to EL10 from 01/02/2020 - 31/03/2020 as a conservative approach.
4. EL11 - Due to delay calibration, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to EL11 from 01/02/2020 - 31/03/2020 as a conservative approach.

Table 5: List of CDM Monitoring Equipment and Calibration for GSS2 (GE No. 4)

No	Item	Parameters	Equipment ID	CDM Monitoring ID	Unit	Manufacturer	Model No.	Serial No.	Accuracy	Range	Last Calibration Date & Cert No.	Recommended Next Calibration Date	Recommended Frequency of Calibration
Gas Supply System													
1	Temperature Transmitter	Temperature (T)	$TT_{1,GSS2}$	T_t ($T_{TT1,GSS2}$)	^0C	Autrol	ATT2100-S11HA3E1-M1	ATT21004151000	±0.1%	0-100°C	18/09/2019 & CTT 3712-19 (01/02/2020 - 31/03/2020)	17/09/2020	Annually
2	Pressure Sensor	Pressure Transmitter (P)	$PT_{2,GSS2}$	P_t ($P_{PT2,GSS2}$)	kPa	Autrol	APT3200-G4M11E11S1-M1	APT3200-4150998	±0.075% of span	-100-1,500kPa	18/09/2019 & CTP 5857-19 (01/02/2020 - 31/03/2020)	17/09/2020	Annually
3	Flow Meter	Flow Rate of Total Gas to Energy ($LFG_{electricity,y}$)	$FT_{3,GSS2}$	$V_{t,\ wb}$ ($LFG_{electricity,GSS2,y}$)	NM^3/hr	Binder	EIA-C100000-1MA100-D1104501-21BS2410	C150327	2.5% of reading + 0.2% of full scale	0.25-25 Nm/s	10/12/2018 & C150327 (01/02/2020 - 31/03/2020)	09/12/2020	24 months
4	Flow Meter	Flow Rate of Total Gas to Energy ($LFG_{electricity,y}$)	$FT_{3,GE4}$ (FT7)	$V_{t,\ wb}$ ($LFG_{electricity,GE4,y}$)	NM^3/hr	CSI Tech	0695-0450	5215-8535	±(1.5% of reading + 0.3% FS)	30.9 -185 m/s	23/11/2015 & RGfs2015-0089 (01/02/2020 - 31/03/2020)	22/11/2016	Annually
Gas Analyser													
5	CH_4 Meter	Methane fraction of LFG	$CH_{4,GSS2}$	$V_{CH4,m,db}$ ($W_{CH4,GSS2,y}$)	%	Edinburgh	Guardian NG	14464	±2% of full scale	0-100%	27/12/2018 & AL-ED/0185-1218 (01/02/2020 - 02/02/2020)	26/12/2019	Annually
											03/02/2020 & AL-ED/0242/0220 (03/02/2020 - 31/03/2020)	02/02/2021	
Power Generation and Electricity Consumption													
6	Power meter	Gross generation from GE No.4	$EL_{LFG,GE\ No.4}$ (EL12)	$EG_{PJ,y}$ ($EL_{LFG,GE\ No.4,y}$)	kWh	EDMI	2000-6N00-30A31-04-L00-02A2-1D	213545834	Class 0.5S	99999999.99kWh	08/08/2018 & SP/RA/2018/463/001-001 (01/02/2020 - 31/03/2020)	07/08/2020	24 months

During this monitoring period, maximum permission error are applied for the equipment which has an delay calibration as conservative approach is as listed below:

1. CH4 - Due to delay calibration, the maximum permissible error of ±2% which is the equipment accuracy error was applied to CH4 from 01/02/2020 - 02/02/2020 as a conservative approach.
2. FT3 (FT7) - Due to delay calibration, the maximum permissible error of ±1.8% which is the equipment accuracy error was applied to FT3 (FT7) from 01/02/2020 - 31/03/2020 as a conservative approach. However, there is no impact to the CER calculation due to FT7 is a backup meter.

Table 6: List of CDM Monitoring Equipment and Calibration for GSSF1 (GE No. 1)

No	Item	Parameters	Equipment ID	CDM Monitoring ID	Unit	Manufacturer	Model No.	Serial No.	Accuracy	Range	Last Calibration Date & Cert No.	Recommended Next Calibration Date	Recommended Frequency of Calibration
Gas Supply System													
1	Temperature Transmitter	Temperature (T)	$TT_{1,GSS\ F1}$	T_t ($T_{TT1,\ GSS\ F1}$)	^0C	PR Electronics	5335A	100944768	≤ ± 0.05% of span	0-100°C	18/09/2019 & CTT 3708-19 (01/02/2020 - 31/03/2020)	17/09/2020	Annually
2	Flow Meter	Flow Rate of Total Gas to Energy ($LFG_{electricity,y}$)	$FT_{3,\ GSS\ F1}$	$V_{t,\ wb}$ ($LFG_{electricity,GSS\ F1,y}$)	NM^3/hr	Flow transmitter – Rosemount Differential Pressure Transmitter – Kingways Control Vcone	3051CD1A22A1AM5B4 K5Q4 / KVS08IIKC23FSN	02768007 / FT161 (11011001)	+0.5%	0-64kPa	18/09/2019 & CTP 5855-19 (01/02/2020 - 31/03/2020)	17/09/2021	24 months
3	Pressure Sensor	Pressure Transmitter (P)	$PT_{2,\ GSS\ F1}$	P_t ($P_{PT2,\ GSS\ F1}$)	kPa	Rosemount	3051TG1A2B21AB4E5 M5Q4	02492864	+0.25%	0 to 207 kPa	18/09/2019 & CTP 5854-19 (01/02/2020 - 31/03/2020)	17/09/2020	Annually
Gas Analysers													
4	CH4 Analyser	Methane fraction of LFG	$CH_{4,\ GSS\ F1}$	$V_{CH4,\ m,\ db}$ ($W_{CH4,GSS\ F1,y}$)	%	Cubic- Ruiyi	Gasboard-3200	2190 5310 2610 0000 0001	<1.0%	0-100%	05/06/2019 & 2019060507 (01/02/2020 - 31/03/2020)	04/06/2020	Annually
Power Generation and Electricity Consumption													
5	Power meter	Total electricity generation (MWh) - recorded by project site (Backup)	$EL_{LFG,GE\ No.1}$ (EL1)	$EG_{PJ,y}$ ($EL_{LFG,GE\ No.1,y}$)	kWh	IME Nemo	96HD+	2167890035	Class 0.5S	99999999.99kWh	25/01/2018 & SP/RA/2018/065/001-004 (01/02/2020 - 31/03/2020)	24/01/2021	36 months
6	Power meter	Total electricity generation (MWh) - recorded by project site	$EL_{LFG,GE\ No.1}$ (EL4)	$EG_{PJ,y}$ ($EL_{LFG,GE\ No.1,y}$)	kWh	EDMI	Genius	210225256	Class 0.5S	99999999.99kWh	14/03/2019 & SP/RA2019/146/001-001 (01/02/2020 - 31/03/2020)	13/03/2021	24 months
7	Power meter	Electricity sell to grid (MWh) - recorded by grid operator	EL_{LFG} (EL5)	$EG_{PJ,y}$ ($EL_{LFG,y}$)	kWh	Itron	SL761A071	53099690	Class 0.20	999999999kWh	01/04/2011 & TNBM-QR-064 (01/02/2020 - 31/03/2020)	31/03/2016	5 years
8	Power meter	Electricity sell to grid (MWh) - check energy meter recorded by grid operator	-	-	kWh	Itron	SL761A071	53099691	Class 0.20	999999999kWh	01/04/2011 & TNBM-QR-064 (01/02/2020 - 31/03/2020)	31/03/2016	5 years

During this monitoring period, maximum permission error are applied for the equipment which has an delay calibration as conservative approach is as listed below:

1. EL5 - Due to delay calibration, the maximum permissible error of ±0.2% which is the equipment accuracy error was applied to EL5 from 01/02/2020 - 31/03/2020 as a conservative approach.

Table 7: List of CDM Monitoring Equipment and Calibration for GSS3 (GE No. 5 and GE No.6)

No	Item	Parameters	Equipment ID	CDM Monitoring ID	Unit	Manufacturer	Model No.	Serial No.	Accuracy	Range	Last Calibration Date & Cert	Recommended	Recommended
Gas Supply System													
1	Temperature Transmitter	Temperature (T)	$TT_{1,GSS3}$	T_t ($T_{TT1,GSS3}$)	^0C	Status Instrument	SEM 710	155132 - 0001	± 2.0%	0 - 100'0	22/02/2019 & 1902 0016/TE/BT (01/02/2020 - 31/03/2020)	21/02/2020	Annually
2	Pressure Sensor	Pressure Transmitter (P)	$PT_{2,GSS3}$	P_t ($P_{PT2,GSS3}$)	kPa	Endress + Hauser	PMP51 - BD21J1 KGCGMJA1	N7014C21129	± 0.1%	0-40kPa	25/07/2018 & P18-0142 (01/02/2020 - 31/03/2020)	24/07/2019	Annually
3	Flow Meter	Flow Rate of Total Gas to Energy ($LFG_{electricity,y}$)	$FT_{3,GSS3}$	$V_{t,\ wb}$ ($LFG_{electricity,GSS3,y}$)	NM^3/hr	Rosemount	2051CD2A02A1AS5M5 C1Q4	3604693	0.065%	0-937mbar	17/08/2018 & 11834565 (01/02/2020 - 31/03/2020)	16/08/2020	24 months
4	Flow Meter	Flow Rate of Total Gas to Energy ($LFG_{electricity,y}$)	$FT_{3,GE5}$ (FT8)	$V_{t,\ wb}$ ($LFG_{electricity,GE5,y}$)	NM^3/hr	Binder	Combimass	C180382	2.5% ± 0.1%	21-1800Nm^3/h	26/07/2018 & BKTGR-FM2 (01/02/2020 - 31/03/2020)	25/07/2023	5 years
5	Flow Meter	Flow Rate of Total Gas to Energy ($LFG_{electricity,y}$)	$FT_{3,GE6}$ (FT9)	$V_{t,\ wb}$ ($LFG_{electricity,GE6,y}$)	NM^3/hr	Binder	Combimass	C180381	2.5% ± 0.1%	21-1800Nm^3/h	26/07/2018 & BKTGR-FM1 (01/02/2020 - 31/03/2020)	25/07/2023	5 years
Gas Analyser													
6	CH_4 Meter	Methane fraction of LFG	$CH_{4,GSS3}$	$V_{CH4,m,db}$ ($W_{CH4,GSS3,y}$)	%	Edihburgh Sensors	Guardian NG	17167	± 2%	0-100%	27/01/2020 & 2607 (01/02/2020 - 31/03/2020)	26/01/2021	Annually
Power Generation and Electricity Consumption													
7	Power meter	Gross generation from GE No.5	$EL_{LFG,GE\ No.5}$ (EL14)	$EG_{PJ,y}$ ($EL_{LFG,GE\ No.5,y}$)	kWh	Mk6N GENIUS EDMI	MK6N 2000 - 6N00-30F31-04-L00-12E3-1E	218287221	Class 0.5S	99999999.99kWh	27/04/2018 & 218287221-4422186 (01/02/2020 - 31/03/2020)	26/04/2020	24 months
8	Power meter	Gross generation from GE No.6	$EL_{LFG,GE\ No.6}$ (EL15)	$EG_{PJ,y}$ ($EL_{LFG,GE\ No.6,y}$)	kWh	Mk6N GENIUS EDMI	MK6N 2000 - 6N00-30F31-04-L00-12E3-1E	218287222	Class 0.5S	99999999.99kWh	27/04/2018 &218287222-4422186 (01/02/2020 - 31/03/2020)	26/04/2020	24 months
9	Power meter	Electricity sold to grid (MWh) - recorded by grid operator	EL_{LFG} (EL16)	$EG_{PJ,y}$ ($EL_{LFG,y}$)	kWh	Genius	MK6E	918703332	Class 0.5S	99999999.99kWh	27/4/2018 (01/02/2020 - 31/03/2020)	26/04/2023	5 years
10	Power meter	Electricity sell to grid (MWh) - check energy meter recorded by grid operator	-	-	kWh	Genius	MK6E	918703333	Class 0.5S	99999999.99kWh	27/4/2018 (01/02/2020 - 31/03/2020)	26/04/2023	5 years

During this monitoring period, maximum permission error are applied for the equipment which has an delay calibration as conservative approach is as listed below:

1. TT1 - Due to delay calibration, the maximum permissible error of ±2.0% which is the equipment accuracy error was applied to TT1 from 21/02/2020 - 31/03/2020 as a conservative approach.
2. PT2 - Due to delay calibration, the maximum permissible error of ±0.25% which is the equipment accuracy error was applied to PT2 from 01/02/2020 - 31/03/2020 as a conservative approach.

With reference to the CDM validation and verification standard for project activities, version 02.0, section 9.2.6, paragraph 366 (a), "Applying the maximum permissible error of the instrument to the measured values taken during the period between the scheduled date of calibration and the actual date of calibration, if the results of the delayed calibration do not show any errors in the measuring equipment, or if the error is smaller than the maximum permissible error", or (b) "Applying the error identified in the delayed calibration test, if the error is beyond the maximum permissible error of the measuring equipment". During this monitoring period, all the equipment which had a delay in calibration, the maximum permissible error (MPE) or the error identified in the delay in calibration are listed below:

List of Equipment from GSS1

1. PT2 - due to delay in calibration, the maximum permissible error of ±0.25% which is the equipment accuracy error was applied to PT2 from 01/02/2020 – 20/02/2020 as a conservative approach.
2. EL9 - Due to delay calibration, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to EL9 from 01/02/2020 - 31/03/2020as a conservative approach.
3. EL10 - Due to delay calibration, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to EL10 from 01/02/2020 - 31/03/2020 as a conservative approach.

List of Equipment from GSS2

1. CH4 - Due to delay calibration, the maximum permissible error of ±2% which is the equipment accuracy error was applied to CH4 from 01/02/2020 - 02/02/2020 as a conservative approach.
2. FT3 (FT7) - Due to delay calibration, the maximum permissible error of ±1.8% which is the equipment accuracy error was applied to FT3 from 01/02/2020 - 31/03/2020 as a conservative approach. However, there is no impact to the CER calculation due to FT7 is a backup meter.

List of Equipment from GSS3

1. TT1 - Due to delay calibration, the maximum permissible error of ±2.0% which is the equipment accuracy error was applied to TT1 from 21/02/2020 - 31/03/2020 as a conservative approach.
2. PT2 - Due to delay calibration, the maximum permissible error of ±0.25% which is the equipment accuracy error was applied to PT2 from 01/02/2020 - 31/03/2020 as a conservative approach.

With reference to the CDM validation and verification standard for project activities, version 02.0, section 9.2.6, paragraph 368, "If the results of the delayed calibration are not available, or the calibration has not been conducted at the time of the verification, the DOE, prior to finalizing the verification, shall request the project participants to conduct the required calibration and shall determine whether the project participants have calculated GHG emission reductions or net anthropogenic GHG removals conservatively using the approach mentioned in paragraph 366 above".

During this monitoring period, there is equipment that is not within the control of the project owner and the calibration has not been conducted at the time of verification. The equipment is as listed below:

List of Equipment from GSSF1

1. EL5 (Itron, serial no.: 53099690) – The meter is owned by the grid operator, TNB and thus, it is not within the control of the project owner. However, due to delay calibration, the maximum permissible error of ±0.2% which is the equipment accuracy error was applied to EL5 from 01/02/2020 - 31/03/2020 as a conservative approach.

List of Equipment from GSS1

1. EL 11 (EDMI Limited, serial no.: 908705152) – The meter is owned by the grid operator, TNB and thus, it is not within the control of the project owner. However, due to delay in calibration, EL11 - Due to delay calibration, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to EL11 from 01/02/2020 - 31/03/2020 as a conservative approach.

Data Collection (for the whole monitoring period)

Based on the monitoring plan, key flaring parameters (temperature, pressure, the flow of gas, CH_4 concentration in LFG) were continuously monitored and recorded via the data logger at the flare system

control room. Continuous flaring data were logged and archived every minute in the database file. These raw data were compiled and analysed for the calculation of Certified Emission Reductions (CERs).

As a back-up data recording system, the on-site workers have manually recorded certain monitored parameters in the Daily Monitoring Log Sheets. These records were scanned into soft copies for electronic filing every month.

Data recorded manually (not recorded in the data logger system), i.e. electricity consumed were recorded in daily monitoring log sheets on a daily basis and compiled in Microsoft (MS) Excel format weekly.

Data Processing

The data logged were archived in .db file format and compiled.

Data recorded were further processed to yield the results required. A specific computation programme (in MS Access) was developed by the CDM Consultant to process continuously monitored data to the required format and summary. An example of data aggregation on-site for the flow rate of LFG at the main pipe is shown as follows:

Parameter: FT_1 (Flow rate of LFG at main pipe)

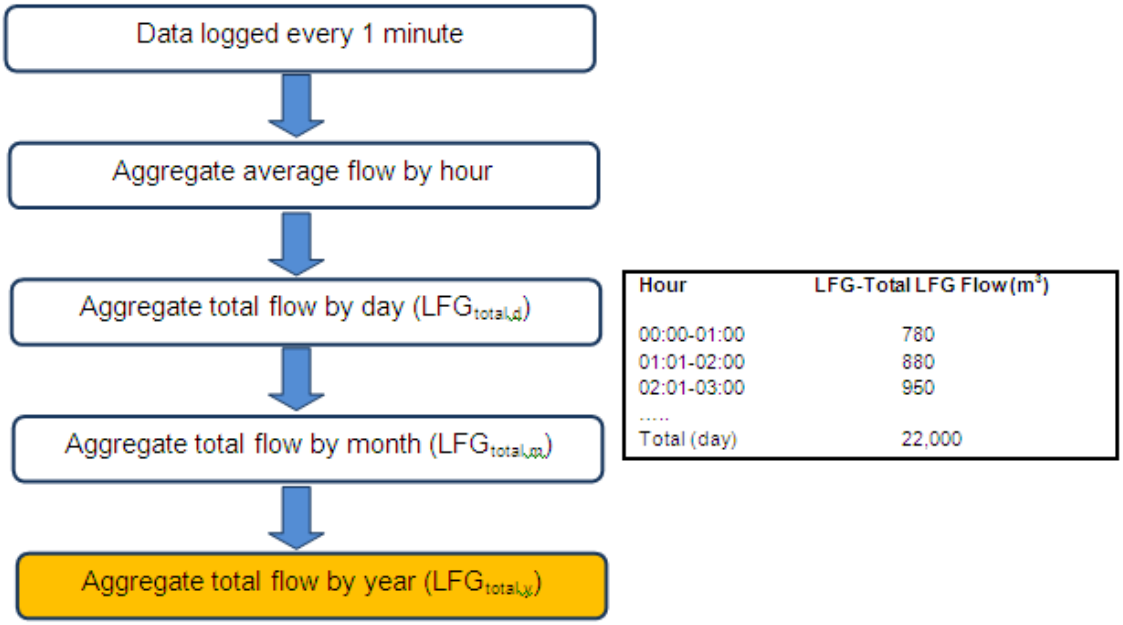


Figure 10: Example of Data Aggregation for Continuous Monitoring

Raw data logged at one (1) minute's interval were used to compute the hourly average. Subsequently, daily readings were computed, followed by aggregation into monthly and finally, yearly summaries.
Similar average values were computed for parameters such as the temperature, pressure, and % CH_4.

Quality Assurance and Quality Control (QA & QC)

Documented Procedures and QA/QC Measures
QA/QC was applied throughout the monitoring period:

- Daily inspection of LFG extraction, flaring, and monitoring systems;
- Checking and counter-signing of data forms by the CDM Manager;
- Data security (restricted access, password control) was applied to ensure the integrity of data;
- Inspection, observations, incidents, and follow-up actions were documented;
- Independent audits were carried out by external consultants; and
- Data were analysed on a weekly basis to determine any irregularities.

Data Management and Storage

A proper data back-up system has been set up to ensure that the data will not be compromised in case of any unforeseen incidents at the site resulting in total loss of data. The retention/archiving period for verification and CER issuance documents should be kept in electronic form for at least 2 years after the crediting period.

Continuous Monitoring (data logging system)

The data from continuous monitoring (data logger) was primarily stored in the hard disk located in the flare control room. To ensure that all data recorded are safe and properly archived, the following back-up system was applied for this project:

Types of back-up	Frequency	Back-up location
Manual back-up using a portable hard disk (HD)	Monthly	At the flare
Automatic back-up to the CDM Manager's PC located at the site office, BTSL	Weekly	On-site (site office)
Data server in the CDM Consultant's office (Eco-Ideal Consulting Sdn. Bhd., Unit C10-4, Tower C, Wisma Goshen, Bangsar Trade Centre, Kuala Lumpur, Malaysia)	Weekly	Off-site (consultant's office)

The data stored in the data server located at the CDM Consultant's office will be used as the primary back-up data in case of any emergency resulting in the loss of data from the flare data recording system. The automatic data back-up system based on internet data transmission can be illustrated as follows:

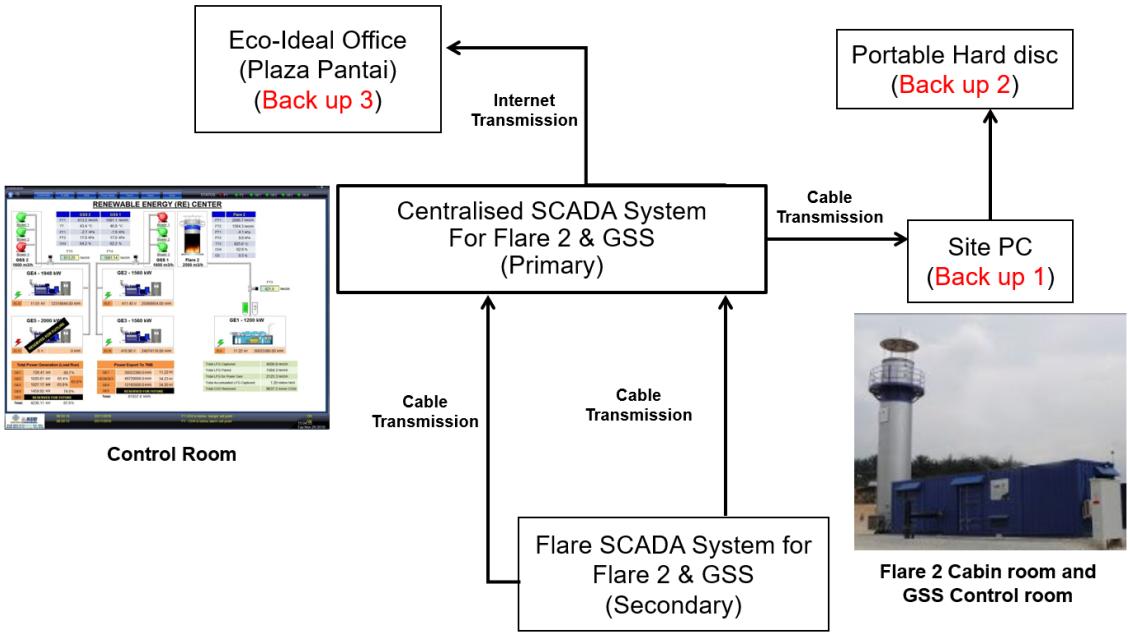


Figure 11: Automatic Data Back-Up for Flaring System at BTSL

Manual Recording

Daily operational data (consisting of CDM parameters monitored) recorded manually was backed-up by scanning all the daily monitoring log sheets on a weekly basis. These data were primarily stored in the computer at the cabin office next to the flare cabin. A copy of these scanned log sheets was handed to the CDM Consultant on a monthly basis for secondary back-up.

Training

Training is important to ensure that all the involved staff is provided with the needed knowledge and skills to undertake their roles effectively according to the CDM MP. There is no training conducted during this monitoring period.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

ACM0001: "Flaring or use of landfill gas" (Version 18.0)

Data / Parameter	**OX_{top_layer}**
Unit	Dimensionless
Description	Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline
Source of data	Consistent with how oxidation is accounted for in the methodological tool "Emissions from solid waste disposal sites"
Value(s) applied)	0.1
Choice of data or measurement methods and procedures	-
Purpose of data	Baseline emissions calculation
Additional comment	-

Data / Parameter	**GWP_{CH4}**
Unit	tCO_2e/tCH_4
Description	Global Warming Potential (GWP) for CH_4
Source of data	IPCC
Value(s) applied)	25
Choice of data or measurement methods and procedures	Shall be updated according to any future COP/MOP decisions
Purpose of data	Baseline emissions calculation
Additional comment	25 for the second commitment period. Shall be updated according to any future COP/MOP decisions

Data / Parameter	**η_{PJ}**
Unit	Dimensionless
Description	Efficiency of the LFG capture system that will be installed in the project activity
Source of data	-
Value(s) applied)	90%
Choice of data or measurement methods and procedures	-
Purpose of data	Baseline emissions calculation
Additional comment	Technical specification of the LFG capture system to be installed (if available) or a default value of 90%

Data / Parameter	$\varphi_{default}$
Unit	-
Description	Default value for the model correction factor to account for model uncertainties
Source of data	-
Value(s) applied)	0.75
Choice of data or measurement methods and procedures	-
Purpose of da	Baseline emissions calculation
Additional comment	$\Phi_y = \varphi_{default}$. 0.75 for Application A, humid/wet conditions

Data / Parameter	**OX**
Unit	-
Description	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data	Based on an extensive review of published literature on this subject, including the "IPCC 2006 Guidelines for National Greenhouse Gas Inventories"
Value(s) applied)	0.1
Choice of data or measurement methods and procedures	-
Purpose of data:	Baseline emission calculation
Additional comment:	-

Data / Parameter	**F**
Unit	-
Description	Fraction of methane in the SWDS gas (volume fraction)
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied)	0.5
Choice of data or measurement methods and procedures	-
Purpose of data	Baseline emissions calculation
Additional comment	-

Data / Parameter	$DOC_{f,default}$
Unit	Weight fraction
Description	Default value for the fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied)	0.5
Choice of data or measurement methods and procedures	-
Purpose of data	Baseline emissions calculation
Additional comment	$DOC_{f,y} = DOC_{f,default}$

Data / Parameter	$MCF_{default}$
Unit	-
Description	Methane Correction Factor
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied)	1.0
Choice of data or measurement methods and procedures	-
Purpose of data	Baseline emissions calculation
Additional comment	$MCF_y = MCF_{default}$.

Data / Parameter	DOC_j
Unit	-
Description	Fraction of degradable organic carbon in the waste type *j* (weight fraction)
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 2.4 and 2.5)
Value(s) applied)	The following values for the different waste types *j* are applied:
Choice of data or measurement methods and procedures	-
Purpose of data	Baseline emissions calculation
Additional comment	-

Waste type *j*	DOC_j (% wet basis)
Wood and wood products	43
Pulp, paper and cardboard (other than sludge)	40
Food, food waste, beverages and tobacco (other than sludge)	15
Textiles	24
Garden, yard and park waste	20
Glass, plastic, metal, other inert waste	0

<table>
<tr><td>Data / Parameter</td><td>kj</td></tr>
<tr><td>Unit</td><td>1/yr</td></tr>
<tr><td>Description</td><td>Decay rate for the waste type j</td></tr>
<tr><td>Source of data</td><td>IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)</td></tr>
<tr><td>Value(s) applied)</td><td>The following values for the different waste types j is applied:

Default values for k_j
<table>
<tr><th colspan="2" rowspan="2">Waste type j</th><th>Tropical (MAT > 20°C)</th></tr>
<tr><th>Wet (MAP > 1,000 mm)</th></tr>
<tr><td rowspan="2">Slowly degrading</td><td>Pulp, paper, cardboard (other than sludge), textiles</td><td>0.07</td></tr>
<tr><td>Wood, wood products and straw</td><td>0.035</td></tr>
<tr><td>Moderately degrading</td><td>Other (non-food) organic putrescible garden and park waste</td><td>0.17</td></tr>
<tr><td>Rapidly degrading</td><td>Food, food waste, sewage sludge, beverages and tobacco</td><td>0.40</td></tr>
</table>
Note: MAT – mean annual temperature, MAP – mean annual precipitation, PET – potential evapotranspiration. MAP/PET is the ratio between the mean annual precipitation and the potential evapotranspiration.</td></tr>
<tr><td>Choice of data or measurement methods and procedures</td><td>-</td></tr>
<tr><td>Purpose of data</td><td>Baseline emissions calculation</td></tr>
<tr><td>Additional comment</td><td>-</td></tr>
</table>

“Project emissions from flaring” (Version 02.0.0)

Data / Parameter	**$SPEC_{flare}$**
Unit	Temperature - °C Flow rate or heat flux – kg/h or m^3/h
Description	Manufacturer’s flare specifications for temperature and flow rate and maintenance schedule
Source of data	Flare manufacturer
Value(s) applied)	Minimum and maximum operating temperature = 0 to 1,200°C Minimum and maximum inlet flow rate = 0 – 2,500 Nm^3/h
Choice of data or measurement methods and procedures	-
Purpose of data	Baseline emissions calculation
Additional comment	-

"Baseline, project and/ or leakage emissions from electricity consumption and monitoring of electricity generation" (Version 02.0)

Data / Parameter	**$TDL_{k,y}$**
Unit	-
Description	Average technical transmission and distribution losses for providing electricity to source *k* in year *y*
Source of data	Tenaga Nasional Berhad (TNB) Annual Report 2016[3] in page 61
Value(s) applied)	7.74%
Choice of data or measurement methods and procedures	Average calculated from year 2014 – 2016 2014 – 8.15% 2015 – 7.68% 2016 – 7.39%
Purpose of data	Project emissions calculation and baseline emissions
Additional comment	For the project emission calculation, TDL of 7.74% is applied from 2017 onwards. 7.74% is calculated from the average of TDL from year 2014 – 2016, the % of the average TDL calculated is higher if compare to TDL in year 2016. This can be concluded that the TDL 7.74% apply for project emission from 2017 onwards is considered conservative approach.

"Tool to calculate the emission factor for an electricity system" (Version 05.0)

Data / Parameter	**$EF_{grid,OM,y}$**
Unit	tCO_2/MWh
Description	Operating margin emission factor for the grid in year *y*
Source of data	2014 Grid connected baseline for Peninsular Malaysia by Green Tech Centre (GTC) CDM Secretariat
Value(s) applied)	0.6532
Choice of data or measurement methods and procedures	The $EF_{grid,OM,y}$ was calculated and published by Green Tech Centre (GTC) CDM Secretariat in 2014 using version 04.0 of the tool. For 2nd crediting period, the emission factor of 2014 is recalculated using W_{OM} = 0.25 according to the "Tool to calculate the emission factor for an electricity system", version 05.0, paragraph 84 (b).
Purpose of data	Calculation of Combined margin emissions factor $EF_{grid,CM,y}$
Additional comment	-

[3] https://www.tnb.com.my/assets/annual_report/TNB_Annual_Report_2016.pdf

Data / Parameter	$EF_{grid,BM,y}$
Unit	tCO_2/MWh
Description	Build margin emission factor for the grid in year *y*
Source of data	2014 Grid connected baseline for Peninsular Malaysia by Green Tech Centre (GTC) CDM Secretariat
Value(s) applied)	0.7350
Choice of data or measurement methods and procedures	The $EF_{grid,BM,y}$ was calculated and published by Green Tech Centre (GTC) CDM Secretariat in 2014 using version 04.0 of the tool. For 2nd crediting period, the emission factor of 2014 is recalculated using W_{BM} = 0.75 according to the "Tool to calculate the emission factor for an electricity system", version 05.0, paragraph 84 (b).
Purpose of data	Calculation of Combined margin emissions factor $EF_{grid,CM,y}$
Additional comment	-

Data / Parameter	$EF_{grid,CM,y}$
Unit	tCO_2/MWh
Description	Combined margin emission factor for the grid in year *y*
Source of data	2014 Grid connected baseline for Peninsular Malaysia by Green Tech Centre (GTC) CDM Secretariat
Value(s) applied)	0.7146
Choice of data or measurement methods and procedures	The EFgrid,CM,y is calculated using published data by Green Tech Centre (GTC) CDM Secretariat in 2014 using version 04.0 of the tool. For 2nd crediting period, the emission factor of 2014 is recalculated according to the "Tool to calculate the emission factor for an electricity system", version 05.0
Purpose of data	Baseline and project emissions calculation
Additional comment	-

"Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 03.0)

Data / Parameter	**MM_{H2O}**
Unit	kg/kmol
Description	Molecular mass of H_2O
Source of data	Methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" *(Version 03.0)*
Value(s) applied)	18.0152
Choice of data or measurement methods and procedures	-
Purpose of data	Baseline emissions calculation
Additional comment	-

Data / Parameter	**R_U**
Unit	$Pa.m^3/kmol.K$
Description	Universal ideal gases constant
Source of data	Methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" *(Version 03.0)*
Value(s) applied)	8,314
Choice of data or measurement methods and procedures	-
Purpose of data	Baseline emissions calculation
Additional comment	-

Data / Parameter	**MM_{CO2}**
Unit	kg/kmol
Description	Molecular mass of greenhouse gas CO_2
Source of data	Methodological tool "Tool to determine the mass flow of a greenhousegas in a gaseous stream" *(Version 03.0)*
Value(s) applied)	44.01
Choice of data or measurement methods and procedures	-
Purpose of data	Baseline emissions calculation
Additional comment	-

Data / Parameter	MM_{CH4}
Unit	kg/kmol
Description	Molecular mass of CH_4
Source of data	Methodological tool “Tool to determine the mass flow of a greenhousegas in a gaseous stream” *(Version 03.0)*
Value(s) applied)	16.04
Choice of data or measurement methods and procedures	-
Purpose of data	Baseline emissions calculation
Additional comment	-

Data / Parameter	MM_{O2}
Unit	kg/kmol
Description	Molecular mass of gas O_2
Source of data	Methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” *(Version 03.0)*
Value(s) applied)	32.00
Choice of data or measurement methods and procedures	-
Purpose of data	Baseline emissions calculation
Additional comment	-

D.2. Data and parameters monitored

ACM0001: "Flaring or use of landfill gas – Version 18.0"

Data/Parameter	Management of SWDS
Unit	-
Description	Management of SWDS
Measured/calculated/ default	-
Source of data	Different sources of data available: (a) Origin design of the landfill; (b) Technical specification for the management of the SWDS; or (c) Local or national regulations.
Value(s) of monitored parameter	Local or national regulations, the reporting is based on the environmental monitoring report submitted to Department of Environment
Monitoring equipment	-
Measuring/reading/recording frequency	Annually
Calculation method (if applicable)	Refer to the original design of the landfill to monitor any practice to increase methane generation during the implementation of the project activity. Any change in the management of the SWDS after the implementation of the project activity will be justified by referring to technical or regulatory specifications.
QA/QC procedures	-
Purpose of data/parameter	-
Additional comments	-

Data / Parameter	$Op_{j,h}$
Unit	-
Description	Operation of the equipment that consumes the LFG
Measured/calculated/default	Measured
Source of data	Project participant
Value(s) applied	On or Off for flare temperature and gas engine
Value(s) of monitored parameter	On or Off for flare temperature and gas engine, refer to $T_{EG,m}$

Dates	Operating Time (Hr) for Flare No.2
01-07/02/2020	0
08-14/02/2020	0
15-21/02/2020	79
22-29/02/2020	87
01-07/03/2020	0
08-14/03/2020	0
15-21/03/2020	0
22-28/03/2020	0
29-31/03/2020	0
Total	**165**

Some operating hour is 0 due to shutdown of flares.

Monitoring equipment	-
Measuring/reading/recording frequency	Hourly

Calculation method (if applicable)	For each equipment unit using the LFG monitor that the plant is operating in hour h by the monitoring any one or more of the following three parameters: • Temperature – Determine the location for temperature measurements and minimum operational temperature based on the manufacturer's specifications of the burning equipment. Document and justify the location and minimum threshold in the PDD; • Flame – Flame detection system is used to ensure that the equipment is in operation; • Products generated. Monitor the generation of steam for the case of boilers and air-heaters and glass for the case of glass melting furnaces. This option is not applicable to brick kilns Flare temperature will be selected for monitoring. Gas engine operation hours will be used for cross-checking. Opj,h = 0 when: • One of more temperature measurements are missing or below the minimum threshold in hour h (instantaneous measurements are made at least every minute); or • Flame is not detected continuously in hour h (instantaneous measurements are made at least every minute). • No products are generated in the hour h. • If gas engine not in operation. Otherwise, Opj,h = 1.
QA/QC procedures	The operation of the equipment that consumes the LFG will be monitored using temperature. The parameter will be measured continuously using a temperature transmitter. The transmitter sensor is installed at the middle top of the enclosed flare stack. Minimum operational temperature in the exhaust gas of the enclosed flare is 500°C. The exhaust gas from the enclosed flares is expected to be in the range of 800-1,200°C. Temperatures above 500°C indicate that the flare is operated in a reliable way where the default value of destruction efficiency of 90% is valid. Temperature transmitter shall be tested, calibrated, and maintained regularly. The detailed information on the temperature is described under $\mathbf{T_{EG,m}}$. The other method to cross-check with the temperature is the operation of gas engines. The operating hour for gas engines is based on actual documented operating hours from site.
Purpose of data/parameter	Baseline emissions calculation
Additional comment	-

Data / Parameter	$\mathbf{EG_{PJ,y}}$ $\mathbf{(EL_{LFG,GE\ No.1,y,}\ EL_{LFG,GE\ No.2,y,}\ EL_{LFG,GE\ No.3,y,}\ EL_{LFG,GE\ No.4,y})}$
Unit	MWh
Description	Amount of electricity generated using LFG by the project activity in year *y*
Measured/calculated/default	Measured
Source of data	Data as measured by electricity meters. This parameter was measured separately for the gas engines, i.e. Gas Engine No.1 (1 meter), Gas Engine No.2 and No.3 (1 meter), and Gas Engine No.4, Gas Engine No.5, and Gas Engine No.6 (1 meter). Therefore,

	three (3) sets of equipment have to be used for the monitoring period.
Value(s) of monitored parameter	Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. The readings will be double-checked by the electricity distribution company. As a quality control procedure, the amount of electricity uploaded to the grid will be measured by other electricity meters (EL5, EL11, and EL16) and compared with the net amount derived from above. The lower value of the amount will be taken as the net amount for emission reduction calculations. The comparison is tabulated as below:

Electricity Meter	
Installed on-site	**Owned by Grid Operator**
EL4	EL5
EL9, and EL10	EL11
EL12, EL14, and EL15	EL16

In the case of a temporary situation where EL16 malfunctions leading to no readings captured, the power generated and uploaded to the grid for Gas Engine No.4, Gas Engine No.5, and Gas Engine No.6 will use the reading captured by EL12, EL14, and EL15. The recorded reading shall be derived based on 95% confidence interval principles (source: "IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories", page 6.6). The lower bound of a 95% confidence interval with reference to the above-mentioned guideline will be applied. An additional 10% will be deducted to the lower bound of the interval boundaries calculated to account for transmission and distribution losses, according to paragraph 231 b)(ii) of "CDM Project Standard for CDM project activities" (Version 02.0).

The detailed calculation was shown in the CER calculation sheet under each monthly 'EL_{PJ}' tab.

Dates	**Net electricity generated (MWh) $EG_{PJ,y}$**			**Total amount of electricity generated (MWh)**
	$EL_{LFG,GE\ No.1,y}$	**$EL_{LFG,GE\ No.2,y}$ & $EL_{LFG,GE\ No.3,y}$**	**$EL_{LFG,GE\ No.4,y}$& $EL_{LFG,GE\ No.5,y}$& $EL_{LFG,GE\ No.6,y}$**	
01-07/02/2020	132.36	293.05	86.13	511.54
08-14/02/2020	129.11	248.92	292.63	670.66
15-21/02/2020	118.80	337.72	0.00	456.52
22-29/02/2020	139.03	352.79	458.26	950.08
01-07/03/2020	97.31	304.21	400.98	802.50
08-14/03/2020	100.44	296.80	568.97	966.22
15-21/03/2020	112.71	302.08	574.90	989.70
22-28/03/2020	112.44	297.84	572.95	983.23
29-31/03/2020	49.36	131.76	234.50	415.61
Total	**992**	**2,565**	**3,189**	**6,746**

The reading for EL5, EL11, and EL16 which is owned by grid operator is cumulative for one (1) month, no weekly data available, as a result, for comparison purposes, the reading for EL5, EL11 and EL16 is proportion according to the weekly ratio calculated from total of EL9 & EL10, and total of EL12, EL14, & EL15. The lower value of the comparison will be taken as

the net amount for emission reduction calculations.

According to CDM Project Standard for Project Activities, version 2.0, Section 8.3.5, Paragraph 241 (a) (i) (a), the CERs estimated (2019 – 2023) above for the increased capacity of 4MW gas engines is only claimed up to 20% (additional 1.1 MW) of the upload capacity stated in original registered PDD (5.5MW). The total maximum upload capacity of 6.6MW is deducted using the actual electricity generated divided by the operation hour. The total power upload to the grid for this monitoring period is not exceeded 6.6MW.

Monitoring equipment

Item	$EG_{PJ,y}$ ($EL_{LFG,GE\ No.1,y}$) Description (EL4)	$EG_{PJ,y}$ ($EL_{LFG,GE\ No.1,y}$) Description (EL5)	
	01/02/2020 – 31/03/2020	01/02/2020 – 31/03/2020	
		Main meter	Check meter
Type	EDMI Genius Power Meter	Itron (SL761A071) Power Meter	
Accuracy class	Class 0.5S	Class 0.20	
Serial No.	210225256	53099690	53099691
Calibration frequency	24 months	5 years	
Date of last calibration	14/03/2019	01/04/2011	
Validity	24 months	5 years (Type 2 according to the Malaysian Grid Code, version 1/2010)	

EL5 (Itron, serial no.: 53099690) – The meter is owned by the grid operator, TNB and thus, it is not within the control of the project owner. However, due to delay in calibration, the maximum permissible error of ±0.2% which is the equipment accuracy error was applied to EL5 from 01/02/2020 – 31/03/2020 as a conservative approach.

Item	$EG_{PJ,y}$ ($EL_{LFG,GE\ No.2,y}$) Description (EL9)	$EG_{PJ,y}$ ($EL_{LFG,GE\ No.3,y}$) Description (EL10)
	01/02/2020 – 31/03/2020	01/02/2020 – 31/03/2020
Type	EDMI Limited (Genius) Power Meter	EDMI Limited (Genius) Power Meter
Accuracy class	Class 0.5S	Class 0.5S
Serial No.	211516862	211516863
Calibration frequency	24 months	24 months
Date of last calibration	25/01/2018	25/01/2018
Validity	24 months	24 months

EL9 and EL10 – Due to delay in calibration, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to EL9 and EL10 from 01/02/2020 – 31/03/2020 as a conservative approach.

Item	$EG_{PJ,y}$ ($EL_{LFG,y}$) Description (EL11)	
	01/02/2020 – 31/03/2020	
	Main energy meter	Check energy meter
Type	EDMI (Mk6E) Power Meter	
Accuracy class	Class 0.5S	
Serial No.	908705152	908705154
Calibration frequency	5 years	
Date of last calibration	06/12/2009	
Validity	5 years (Type 2 according to the Malaysian Grid Code, version 1/2010)	

EL 11 (EDMI Limited, serial no.: 908705152) – The meter is owned by the grid operator, TNB and thus, it is not within the control of the project owner. However, due to delay in calibration, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to EL11 from 01/02/2020 – 31/03/2020 as a conservative approach.

Item	$EG_{PJ,y}$ ($EL_{LFG,GE\ No.4,y}$) Description (EL12)
	01/02/2020 – 31/03/2020
Type	EDMI Limited (2000-6N00-30A31-04-L00-02A2-1D) Power Meter
Accuracy class	Class 0.5S
Serial No.	213545834
Calibration frequency	24 months
Date of last calibration	08/08/2018
Validity	24 months

Item	$EG_{PJ,y}$ ($EL_{LFG,GE\ No.5,y}$) Description (EL14)	$EG_{PJ,y}$ ($EL_{LFG,GE\ No.6,y}$) Description (EL15)
	01/02/2020 – 31/03/2020	01/02/2020 – 31/03/2020
Type	Mk6N Genius EDMI	Mk6N Genius EDMI
Accuracy class	Class 0.5S	Class 0.5S
Serial No.	218287221	218287222
Calibration frequency	24 months	24 months
Date of last calibration	27/04/2018	27/04/2018
Validity	24 months	24 months

	<table><tr><th rowspan="3">Item</th><th colspan="2">$EG_{PJ,y}$ ($EL_{LFG,y}$) Description (EL16)</th></tr><tr><th colspan="2">01/02/2020 – 31/03/2020</th></tr><tr><th>Main energy meter</th><th>Check energy meter</th></tr><tr><td>Type</td><td colspan="2">Genius (MK6E)</td></tr><tr><td>Accuracy class</td><td colspan="2">Class 0.5S</td></tr><tr><td>Serial No.</td><td>918703332</td><td>918703333</td></tr><tr><td>Calibration frequency</td><td colspan="2">5 years</td></tr><tr><td>Date of last calibration</td><td colspan="2">27/04/2018</td></tr><tr><td>Validity</td><td colspan="2">5 years (Type 2 according to the Malaysian Grid Code, version 1/2010)</td></tr></table>
Measuring/reading/recording frequency	Measured continuously with electricity meter installed
Calculation method (if applicable)	N/A
QA/QC procedures	Electricity meters (except the meters owned by the grid operator, i.e. EL4, EL9, EL10, EL12, EL14, and EL15) will be checked and calibrated regularly according to manufacturer's recommendations. The meters EL5, EL11, and EL16 are owned by the grid operator and thus, they are not within the control of the project owner. The calibration of these meters will be based on the grid operator's requirement and standard practice.
Purpose of data/parameter	Baseline emissions calculation
Additional comment	This parameter is required for calculating baseline emissions associated with electricity generation (BEEC,y) using the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption". The meters EL5, EL11, and EL16 are owned by the grid operator and thus, they are not within the control of the project. The calibration of the meters will be based on the grid operator's requirement and standard practice.

Data / Parameter	**$EG_{EC,y}$**
Unit	MWh
Description	Amount of electricity consumed by the project activity in year *y*
Measured/calculated/default	Measured
Source of data	The consumption of electricity ex-post will be measured by ammeters (electricity meters). The quantity of electricity consumed by project activity will be recorded by installed electricity meter EL6 which measured the total electricity consumed by the project activity (Flare 2, Gas Engine No.1, Gas Engine No.2, Gas Engine No.3, and Gas Engine No.4, GSS No.1, GSS No.2, GSS No.3 and GSS F1) In case of temporary situation such as the installed electricity meter mal-functioned (EL6) leading to no readings captured, **$EG_{EC,y}$** shall be estimated or calculated as described as below:

1. Using the backup meter EL1 which recorded the actual power consumption for Flare 2 and GSSF1;

2. For Gas Engine No. 2, Gas Engine No.3, Gas Engine No.4, GSS No.1 GSS No.2, and GSS No.3, the power consumption will be estimated using the power rating (technical specifications) of the system involved during the power generation. The power consumed will be calculated based on the operating maximum capacity for the full period, including the 10% addition to account for transmission and distribution losses, according to PRC-2467-02. In the case of project GHG emissions related to the consumption of electricity, the estimate shall include an addition of 10% to account for transmission and distribution losses.

In the case of a temporary situation where EL1 malfunctions leading to no readings captured, the power consumption for Flare 2 and GSS F1 will use the estimated historical data (Sept 2014 to Aug 2016) of 56.93 MWh per month and compared with the calculated future 24 months' data prior to the malfunction period and, whichever value that is higher will be applied for the project emissions calculation.

The higher power consumption selected for the project emission calculation shall be derived based on 95% confidence interval principles (source: "IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories", page 6.6). The upper bound of 95% confidence interval with reference to the above-mentioned guideline to be applied. Additional 10% will be added to the upper bound of the interval boundaries calculated to account for transmission and distribution losses, according to PRC-2467-02. In the case of project GHG emissions related to the consumption of electricity, the estimate shall include an addition of 10% to account for transmission and distribution losses.

Value(s) of monitored parameter

Dates	Electricity consumed $EG_{EC,y}$ (EL6) (MWh)
01-07/02/2020	41.46
08-14/02/2020	47.53
15-21/02/2020	37.62
22-29/02/2020	67.58
01-07/03/2020	57.27
08-14/03/2020	63.17
15-21/03/2020	64.56
22-28/03/2020	64.04
29-31/03/2020	27.49
Total	**470.72**

<table>
<tr><td>Monitoring equipment</td><td>
<table>
<tr><th>Item</th><th>Electricity consumed from grid for project activity $EG_{EC,y}$ ($EL_{PJ,y}$) (EL6) (MWh)</th></tr>
<tr><td></td><td>01/02/2020 – 31/03/2020</td></tr>
<tr><td>Type</td><td>IME NEMO 96HO+
Power Meter</td></tr>
<tr><td>Accuracy class</td><td>Class 1 (± 1%)</td></tr>
<tr><td>Serial No.</td><td>2661930098</td></tr>
<tr><td>Calibration frequency</td><td>36 months</td></tr>
<tr><td>Date of last calibration</td><td>25/01/2018</td></tr>
<tr><td>Validity</td><td>3 years according to manufacturer’s recommendation</td></tr>
</table>
</td></tr>
<tr><td>Measuring/reading/recording frequency</td><td>Continuous measurement</td></tr>
<tr><td>Calculation method (if applicable)</td><td>N/A</td></tr>
<tr><td>QA/QC procedures</td><td>Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. The readings will be double-checked by the electricity distribution company</td></tr>
<tr><td>Purpose of data/parameter</td><td>Project emission calculation</td></tr>
<tr><td>Additional comment</td><td>This parameter is required for calculating project emissions from electricity consumption due to an alternative waste treatment process t ($PE_{EC,y}$) using the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”</td></tr>
</table>

"Emissions from solid waste disposal sites" (Version 08.0)

Data / Parameter	f_y
Unit	-
Description	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year *y*
Measured/calculated/default	
Source of data	Onsite records of the gas analyzers.
Value(s) of monitored parameter	

Dates	Flare No.2 Value (%)	GSS1 Value (%)	GSS2 Value (%)	GSS3 Value (%)	GSSF1 Value (%)
01-07/02/2020	0.00	0.61	0.00	0.64	0.63
08-14/02/2020	0.00	0.63	0.00	0.64	0.63
15-21/02/2020	0.64	0.64	0.00	0.00	0.62
22-29/02/2020	0.62	0.59	0.00	0.61	0.64
01-07/03/2020	0.00	0.58	0.00	0.61	0.63
08-14/03/2020	0.00	0.58	0.00	0.61	0.65
15-21/03/2020	0.00	0.56	0.00	0.61	0.64
22-28/03/2020	0.00	0.57	0.00	0.61	0.65
29-31/03/2020	0.00	0.57	0.00	0.61	0.65
Average	**0.63**	**0.59**	**0.00**	**0.62**	**0.64**

Some of the methane fraction reading is 0 is due to the shutdown of flares and gas engines.

Monitoring equipment	
Measuring/reading/recording frequency	For application A: Once for the crediting period (f_y = f)
Calculation method (if applicable)	N/A
QA/QC procedures	-
Purpose of data/parameter	Baseline emissions calculation
Additional comment	This is for reporting purposes, and not applied in the ER calculation

"Project emissions from flaring" (Version 03.0)

<table>
<tr><td>Data / Parameter</td><td>$T_{EG,m}$ ($T_{Flare,F2}$)</td></tr>
<tr><td>Unit</td><td>°C</td></tr>
<tr><td>Description</td><td>Temperature in the exhaust gas of the enclosed flare in minute m</td></tr>
<tr><td>Measured/calculated/default</td><td>Measured</td></tr>
<tr><td>Source of data</td><td>Project participant</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><th>Dates</th><th>$T_{EG,m}$ ($T_{Flare,F2}$) (°C)</th></tr>
<tr><td>01-07/02/2020</td><td>0.00</td></tr>
<tr><td>08-14/02/2020</td><td>0.00</td></tr>
<tr><td>15-21/02/2020</td><td>698.41</td></tr>
<tr><td>22-29/02/2020</td><td>582.26</td></tr>
<tr><td>01-07/03/2020</td><td>0.00</td></tr>
<tr><td>08-14/03/2020</td><td>0.00</td></tr>
<tr><td>15-21/03/2020</td><td>0.00</td></tr>
<tr><td>22-28/03/2020</td><td>0.00</td></tr>
<tr><td>29-31/03/2020</td><td>0.00</td></tr>
<tr><td>Average</td><td>640.34</td></tr>
</table>
Some of the flare temperature reading is 0 due to shutdown of flares.
</td></tr>
<tr><td>Monitoring equipment</td><td>
<table>
<tr><th rowspan="2">Item</th><th>$T_{EG,m}$ ($T_{Flare,F2}$) Description</th></tr>
<tr><th>01/02/2020 – 31/03/2020</th></tr>
<tr><td>Type</td><td>Honeywell (STT25M-0-EN0-000-000-000-00 3D) Temperature Transmitter</td></tr>
<tr><td>Accuracy class</td><td>± 0.5% of span</td></tr>
<tr><td>Serial No.</td><td>B838901937</td></tr>
<tr><td>Calibration frequency</td><td>Annually</td></tr>
<tr><td>Date of last calibration</td><td>18/09/2019</td></tr>
<tr><td>Validity</td><td>1 year</td></tr>
</table>
</td></tr>
<tr><td>Measuring/reading/recording frequency</td><td>Once per minute</td></tr>
<tr><td>Calculation method (if applicable)</td><td>Measure the temperature of the exhaust gas in the flare by an appropriate temperature measurement equipment.

The temperature of the exhaust gas in the flares is measured by temperature transmitters.

The exhaust gas from the enclosed flares is expected to be in the range of 800 – 1,200°C. Temperatures above 500°C indicate that the flare is operated in a reliable way where the default value of destruction efficiency of 90% is valid. Minimum operational temperature in the exhaust gas of the enclosed flare is 500°C.</td></tr>
<tr><td>QA/QC procedures</td><td>Temperature measurement equipment is calibrated in accordance with the maintenance schedule</td></tr>
<tr><td>Purpose of data/parameter</td><td>Baseline emissions calculation</td></tr>
</table>

Additional comment	Any unexpected changes such as a sudden increase/drop in temperature will be noted in the site records along with any corrective action that was implemented to correct the issue. Monitoring of this parameter is applicable in case of enclosed flares. Measurements are required to determine if manufacturer's flare specifications for operating temperature are met

Data / Parameter	**$Flame_m$**
Unit	Flame on or Flame off
Description	Flame detection of flare in the minute *m*
Measured/calculated/default	Measured
Source of data	Project participant
Value(s) of monitored parameter	On or Off, refer to $\mathbf{V_{t,wb}}$
Monitoring equipment	Fixed installation optical flame detector: Ultra-violet detector
Measuring/reading/recording frequency	Once per minute. Detection of flame recorded as a minute that the flame was on, otherwise recorded as a minute that the flame was off.
Calculation method (if applicable)	Measured using a fixed installation optical flame detector: Ultra Violet detector
QA/QC procedures	The flame detection will be monitored and cross checked with the amount of gas sent to flare (FT2) and gas engine (FT3). If there is data for FT2 and FT3, means the flame is on. Equipment will be maintained and calibrated in accordance with manufacturer's recommendations
Purpose of data/parameter	Baseline emissions calculation
Additional comment	Applicable to all flares

"Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 03.0)

Data / Parameter	**$V_{t,wb}$ ($LFG_{Flare,\ Flare\ No.2,y}$, $LFG_{electrcity,GSS1,y}$, $LFG_{electrcity,GSS2,y}$ $LFG_{electrcity,GSSF1,y}$)**
Unit	m^3 wet gas/h
Description	Volumetric flow of the gaseous stream in time interval *t* on a wet basis
Measured/calculated/default	Measured
Source of data	Onsite records of the flow meters. There is an independent flow meter to measure the gas sent to Flare 2 (FT1F2 & FT2F2), GSS1 (FT3GSS1), GSS2 (FT3GSS2), GSS3 (FT3GSS3) and GSS F1 (FT3GSSF1). There are two (2) sets of flow meter to measure the gas sent to Gas Engine No.4, Gas Engine No.5 and Gas Engine No. 6. 1st set of the meter will measure the total amount of gas sent to GSS2 (FT3GSS2) and GSS3 (FT3GSS3) before sent to respective gas engines. Another set of the meter will measure the total amount of gas sent to specific gas engine No. 4 (FT7), gas engine No. 5 (FT8) and gas engine No. 6 (FT9). In the case of temporary situation where FT3GSS2 or FT3GSS3 malfunctions leading to no readings captured, the flow of gas sent to gas engines will use the reading captured by respective flow meter (FT7, FT8 and FT9). The recorded reading shall be derived based on 95% confidence interval principles (source: "IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories", page 6.6). The lower bound of 95% confidence interval with reference to the above-mentioned guideline will be applied. Alternately, the record from the daily manual log-sheet will be used to calculate the lower bound of 95% confidence interval. The lower bound of the interval boundaries calculated will be applied to the period for the constant data as a conservative approach. There are two (2) sets of flow meter (FT1F2 & FT2F2) to measure the gas sent to Flare 2. Flow obtained from FT2F2 will be used for the calculation. During temporary malfunctioning of FT2F2 or data logging system resulting in unrepresentative data, the value of FT1F2 will be used for the calculation. According to CDM Project Standard for Project Activities, version 2.0, Section 8.3.5, Paragraph 241 (a) (i) (a), the CERs estimated (2019 – 2023) above for the increase capacity of 4MW gas engines is only claimed up to 20% (additional 1.1 MW) of the upload capacity stated in original registered PDD (5.5MW). In the case of the total actual electricity uploaded to grid is more than 6.6MW, the additional flow will be deducted from the calculation. The additional flow (from any of the flow meters) will be calculated based on the MWh calculated in $EG_{PJ,y}$ by using the estimated unit amount of m^3 to produce the additional electricity generation. During this monitoring period, the total actual electricity uploaded to grid is less than 6.6MW.

Value(s) of monitored parameter

LGF_{total} - Total amount of LFG sent to flare/captured during the project at normal temperature and pressure:

Flare No.2

According to ACM0001, version 18, page 15, if the LFG is used for multiple purposes (e.g. flaring or energy generation), and all methane destruction devices are verified to be operational (e.g. by means of flame detector records, energy generated), a single flow meter may be used to record the flow into multiple destruction devices.

However, as Gas Engine No.1 was converted to GSSF1 which started to operate on 01/06/2017, only one flow meter (FT2) remained for Flare No. 2, therefore, no comparison was done started from June 17 onwards.

Dates	$V_{t,wb}$ ($LFG_{Flare,Flare\ No.2,y}$) $FT_{2,\ Flare\ No.2}$ (Nm^3)
01-07/02/2020	0
08-14/02/2020	0
15-21/02/2020	48,882
22-29/02/2020	49,829
01-07/03/2020	0
08-14/03/2020	0
15-21/03/2020	0
22-28/03/2020	0
29-31/03/2020	0
Total	**98,711**

Some of the FT2 reading is 0 is due to the shutdown of flares.

GSSF1 (Gas Engine No.1), GSS1 (Gas Engine No.2 and 3), GSS2 (Gas Engine No.4) and GSS3 (Gas Engine No.5 and No.6)

According to ACM0001, version 18, page 15, if the LFG is used for multiple purposes (e.g. flaring or energy generation), and all methane destruction devices are verified to be operational (e.g. by means of flame detector records, energy generated), a single flow meter may be used to record the flow into multiple destruction devices. In the case where LFG is just sent to the power plants (gas engines) for electricity generation, one flow meter can be used provided that these meters used are calibrated periodically by an officially accredited entity. The total LFG captured was the same as the total LFG sent to the gas engines for GSS F1, GSS1, GSS2, and GSS3 respectively during the monitoring period.

Dates	$V_{t,\ wb}$ ($LFG_{electrcity,GSS1,y}$) $FT_{3,\ GSS1}$ (Nm^3)	$V_{t,\ wb}$ ($LFG_{electrcity,GSS2,y}$) $FT_{3,\ GSS2}$ (Nm^3)	$V_{t,\ wb}$ ($LFG_{electrcity,GSSF1,y}$) $FT_{3,\ GSS3}$ (Nm^3)	$V_{t,\ wb}$ ($LFG_{electrcity,GSSF1,y}$) $FT_{3,\ GSSF1}$ (Nm^3)
01-07/02/2020	180,304	0	55,925	95,323
08-14/02/2020	139,622	0	166,794	90,397
15-21/02/2020	195,829	0	0	82,228
22-29/02/2020	210,986	0	267,532	101,655
01-07/03/2020	200,473	0	238,759	81,410
08-14/03/2020	197,354	0	346,521	81,528
15-21/03/2020	205,798	0	347,594	95,580
22-28/03/2020	203,462	0	351,498	95,515

29-31/03/2020	92,420	0	143,986	43,174
Total	**1,626,247**	**0**	**1,918,608**	**766,810**

The reading for FT3 GSS2 is 0 is due to the shutdown of gas engines (major overhaul).

Monitoring equipment

Item	**Flare No.2, $LFG_{flare,Flare\ No.2,y}$ ($FT_{1,\ Flare\ No.2}$)**
	01/02/2020 – 31/03/2020
Type	Flow transmitter – Rosemount Differential Pressure Transmitter – Kingways Control Vcone
Accuracy class	± 1%
Serial No.	4972946 (Rosemount) / FT119 (8102101) (Kingways)
Calibration frequency	24 months
Date of last calibration	04/06/2018
Validity	24 months

Item	**Flare No.2, $LFG_{flare,Flare\ No.2,y}$ ($FT_{2,\ Flare\ No.2}$)**
	01/02/2020 – 31/03/2020
Type	Flow transmitter – Rosemount Differential Pressure Transmitter – Kingways Control Vcone
Accuracy class	± 0.5%
Serial No.	5476627 (Rosemount) / FT140 (10031701) (Kingways)
Calibration frequency	24 months
Date of last calibration	04/06/2018
Validity	24 months

Item	**GSS1, $LFG_{electricity,GSS1,y}$ ($FT_{3,\ GSS1}$)**
	01/02/2020 – 31/03/2020
Type	Flow transmitter – Rosemount
Accuracy class	± 0.5%
Serial No.	5988022
Calibration frequency	24 months
Date of last calibration	11/10/2018
Validity	24 months

Item	**GSS2, $LFG_{electricity,GSS2,y}$ ($FT_{3,\ GSS2}$)**
	01/02/2020 – 31/03/2020
Type	Flow transmitter – Binder
Accuracy class	± 2.5% of reading + 0.2% of full scale
Serial No.	C150327
Calibration frequency	24 months
Date of last calibration	10/12/2018
Validity	24 months

Item	Gas Engine No. 4 $LFG_{electricity,GE4}$ (FT7)
	01/02/2020 – 31/03/2020
Type	Flow transmitter – CSI Tech
Accuracy class	±(1.5% of reading + 0.3% FS)
Serial No.	5215-8535
Calibration frequency	12 months
Date of last calibration	23/11/2015
Validity	12 months

FT3 (FT7) - Due to delay calibration, the maximum permissible error of ±1.8% which is the equipment accuracy error was applied to FT3 (FT7) from 01/02/2020 - 31/03/2020 as a conservative approach.

Item	GSS3, $LFG_{electricity,GSS3,y}$ ($FT_{3, GSS3}$)
	01/02/2020 – 31/03/2020
Type	Flow transmitter – Rosemount
Accuracy class	± 0.5%
Serial No.	5988022 (Rosemount)
Calibration frequency	24 months
Date of last calibration	11/10/2018
Validity	24 months

Item	Gas Engine No. 5 $LFG_{electricity,GE5}$ (FT8)
	01/02/2020 – 31/03/2020
Type	Flow transmitter – Binder
Accuracy class	2.5% ± 0.1%
Serial No.	C180382
Calibration frequency	5 years
Date of last calibration	26/07/2018
Validity	5 years

Item	Gas Engine No. 6 $LFG_{electricity,GE5}$ (FT9)
	01/02/2020 – 31/03/2020
Type	Flow transmitter – Binder
Accuracy class	2.5% ± 0.1%
Serial No.	C180381
Calibration frequency	5 years
Date of last calibration	26/07/2018
Validity	5 years

Item	GSSF1, $LFG_{electricity,GSSF1,y}$ ($FT_{3, GSSF1}$)
	01/02/2020 – 31/03/2020
Type	Flow transmitter – Rosemount Differential Pressure Transmitter – Kingways Control Vcone
Accuracy class	± 0.5%

	<table><tr><td>Serial No.</td><td>02768007 (Rosemount) / FT161 (11011001) (Kingways)</td></tr><tr><td>Calibration frequency</td><td>24 months</td></tr><tr><td>Date of last calibration</td><td>18/09/2019</td></tr><tr><td>Validity</td><td>24 months</td></tr></table>
Measuring/reading/recording frequency	Continuous if not specified in the underlying methodology/tool
Calculation method (if applicable)	Instruments with recordable electronic signal (analogical or digital) is used
QA/QC procedures	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory for all projects applying large scale methodology (ies). Calibration and frequency of calibration is according to manufacturer's specifications
Purpose of data/parameter	Baseline emissions calculation
Additional comment	This parameter is monitored in Option B

Data / Parameter	**$V_{CH4,m,db}$ ($W_{CH4,Flare\ No.2,y}$, $W_{CH4,GSS1,y}$, $W_{CH4,GSS2,y}$, $W_{CH4,GSSF1,y}$)**
Unit	m^3 CH_4 / m^3 dry gas
Description	Volumetric fraction of greenhouse gas CH_4 in minute *m* on a dry basis
Measured/calculated/default	Measured
Source of data	Onsite records of the gas analyzers. In case of temporary situation such as the installed CH_4 gas analyser mal-functioned or giving unrepresentative results due to data logging problem, the V_{CH4} shall be measured manually with portable gas analyser. For any affected day, the calculation of the values measured using the portable analyser will be based on the Guidelines to calculate the fraction of methane in the landfill gas from periodical measurements (Version 01). As conservative approach, the lower bound of the 95% Confidence Interval will be applied as per guideline.
Value(s) of monitored parameter	<table><tr><th>Dates</th><th>Flare No.2 Value (%)</th><th>GSS1 Value (%)</th><th>GSS2 Value (%)</th><th>GSS3 Value (%)</th><th>GSSF1 Value (%)</th></tr><tr><td>01-07/02/2020</td><td>0.00</td><td>0.61</td><td>0.00</td><td>0.64</td><td>0.63</td></tr><tr><td>08-14/02/2020</td><td>0.00</td><td>0.63</td><td>0.00</td><td>0.64</td><td>0.63</td></tr><tr><td>15-21/02/2020</td><td>0.64</td><td>0.64</td><td>0.00</td><td>0.00</td><td>0.62</td></tr><tr><td>22-29/02/2020</td><td>0.62</td><td>0.59</td><td>0.00</td><td>0.61</td><td>0.64</td></tr><tr><td>01-07/03/2020</td><td>0.00</td><td>0.58</td><td>0.00</td><td>0.61</td><td>0.63</td></tr><tr><td>08-14/03/2020</td><td>0.00</td><td>0.58</td><td>0.00</td><td>0.61</td><td>0.65</td></tr><tr><td>15-21/03/2020</td><td>0.00</td><td>0.56</td><td>0.00</td><td>0.61</td><td>0.64</td></tr><tr><td>22-28/03/2020</td><td>0.00</td><td>0.57</td><td>0.00</td><td>0.61</td><td>0.65</td></tr><tr><td>29-31/03/2020</td><td>0.00</td><td>0.57</td><td>0.00</td><td>0.61</td><td>0.65</td></tr><tr><td>Average</td><td>0.63</td><td>0.59</td><td>0.00</td><td>0.62</td><td>0.64</td></tr></table> Some of the CH4 reading is 0 is due to the shutdown of flares and gas engines.

Monitoring equipment

Item	Flare No.2, $W_{CH4,Flare\ No.2,y}$ ($CH_{4,\ Flare\ No.2}$)
	01/02/2020 – 31/03/2020
Type	Guardian Plus (97460) Infra-Red Gas Monitor
Accuracy class	± 2%
Serial No.	33542
Calibration frequency	Annually
Date of last calibration	18/09/2019
Validity	1 year

Item	GSS1, $W_{CH4,GSS1,y}$ ($CH_{4,\ GSS1}$)
	01/02/2020 – 31/03/2020
Type	Guardian Plus (97460) Infra-Red Gas Monitor
Accuracy class	± 2%
Serial No.	33436
Calibration frequency	Annually
Date of last calibration	26/07/2019
Validity	1 year

Item	GSS2, $W_{CH4,GSS2,y}$ ($CH_{4,\ GSS2}$)	
	01/02/2020 – 02/02/2020	03/02/2020 – 31/03/2020
Type	Edinburgh Guardian Ng	
Accuracy class	± 2%	
Serial No.	14464	
Calibration frequency	Annually	
Date of last calibration	27/12/2018	03/02/2020
Validity	1 year	

GSS2

CH4 - Due to delay calibration, the maximum permissible error of ±2% which is the equipment accuracy error was applied to CH4 from 01/02/2020 - 02/02/2020 as a conservative approach.

Item	GSS3, $W_{CH4,GSS3,y}$ ($CH_{4,\ GSS3}$)
	01/02/2020 – 31/03/2020
Type	Edihburgh Sensors
Accuracy class	± 2%
Serial No.	17167
Calibration frequency	Annually
Date of last calibration	27/01/2020
Validity	1 year

Item	GSSF1, $W_{CH4,GSSF1,y}$ ($CH_{4,GSSF1}$)
	01/02/2020 – 31/03/2020
Type	Cubic-Ruiyi
Accuracy class	± 1.0%

	Serial No. 21905310261000000001 Calibration frequency: Annually Date of last calibration: 05/06/2019 Validity: 1 year
Measuring/reading/recording frequency	The CH_4 fraction were measured continuously with certified equipment or measured manually with a portable gas analyser during emergency cases
Calculation method (if applicable)	Raw data logged at 1 minute's interval was used to compute the daily average readings
QA/QC procedures	Calibration should include zero verification with an inert gas (e.g. N2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period
Purpose of data/parameter	Baseline emission calculation
Additional comment	This parameter is monitored in Option B

Data / Parameter	**T_t ($T_{TT1,F2}$, $T_{TT1,GSS1}$, $T_{TT1,GSS2}$, $T_{TT1,GSSF1}$)**
Unit	K
Description	Temperature of the gaseous stream in time interval *t*
Measured/calculated/default	Measured
Source of data	Onsite records of the temperature. In the case of temporary situation where Tt malfunctions leading to no readings captured, according to Tool to determine the mass flow of a greenhouse gas in a gaseous stream Version 03.0, data substitution procedure is as follow:

Duration of Missing Data	Data Substitution procedure
Less than six hours	Use the weighted average of the four hours period immediately before and four hours period immediately after the outage
Six to 24 hours	Use the upper bound of 95% confidence interval of the data spanning 24 hours prior to and 24 hours after the outage, whichever results in more conservative estimate of emission reductions
One to seven days	Use the upper bound of 95% confidence interval of the data spanning 72 hours prior to and 72 hours after the outage, whichever results in more conservative estimate of emission reductions
Greater than one week	No data may be substituted

Value(s) of monitored parameter

Dates	T_t (°C)				
	$T_{TT1,F2}$	$T_{TT1,GSS1}$	$T_{TT1,GSS2}$	$T_{TT1,GSS3}$	$T_{TT1,GSSF1}$
01-07/02/2020	0.00	45.60	0.00	47.55	46.36
08-14/02/2020	0.00	42.37	0.00	52.08	45.16
15-21/02/2020	33.60	45.95	0.00	0.00	44.72
22-29/02/2020	34.91	48.85	0.00	57.49	46.94
01-07/03/2020	0.00	47.32	0.00	56.43	46.32
08-14/03/2020	0.00	47.72	0.00	60.44	47.61
15-21/03/2020	0.00	48.27	0.00	60.85	47.64
22-28/03/2020	0.00	47.60	0.00	59.97	47.61
29-31/03/2020	0.00	48.49	0.00	60.23	47.88
Average	**34.25**	**46.91**	**0.00**	**56.88**	**46.69**

Some of the ttemperature of the gaseous stream reading is 0 is due to the shutdown of flares and gas engines.

Monitoring equipment

Item	Flare No.2, T_t ($T_{TT1,F2}$)
	01/02/2020 – 31/03/2020
Type	Honeywell (STT25M-0-EN0-000-000-000-00-3D) Temperature Transmitter
Accuracy class	± 0.5% of span
Serial No.	B839917437
Calibration frequency	Annually
Date of last calibration	18/09/2019
Validity	1 year

Item	GSS1, T_t ($T_{TT1,GSS1}$)
	01/02/2020 – 31/03/2020
Type	Honeywell (STT25M-0-ENS-000-000-000-00-3H) Temperature Transmitter
Accuracy class	± 1%
Serial No.	B527143837
Calibration frequency	Annually
Date of last calibration	18/09/2019
Validity	1 year

Item	GSS2, T_t ($T_{TT1,GSS2}$)
	01/02/2020 – 31/03/2020
Type	Autrol (ATT2100-S11HA3E1-M1) Temperature Transmitter
Accuracy class	± 0.1%
Serial No.	ATT21004151000
Calibration frequency	Annually
Date of last calibration	18/09/2019
Validity	1 year

Item	GSS3, T_t ($T_{TT1,GSS3}$)
	01/02/2020 – 31/03/2020
Type	Status Instrument (SEM 710)
Accuracy class	± 2.0%

	Serial No. 155132 - 0001 Calibration frequency: Annually Date of last calibration: 22/02/2019 Validity: 1 year **Item** / **GSSF1, T_t ($T_{TT1,GSSF1}$)** / **01/02/2020 – 31/03/2020** Type: PR Electronics (5335A) Temperature Transmitter Accuracy class: ≤ ± 0.05% of span Serial No. 100944768 Calibration frequency: Annually Date of last calibration: 18/09/2019 Validity: 1 year
Measuring/reading/recording frequency	Measured continuously by temperature meter
Calculation method (if applicable)	Raw data logged at 1 minute's interval was used to compute the daily average readings
QA/QC procedures	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications
Purpose of data/parameter	Baseline emission calculation
Additional comment	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency). However, if the applicability condition related to the gaseous stream flow temperature being below 60ºC is adopted, this parameter must be monitored continuously to assure the applicability condition is met

Data / Parameter	**P_t ($P_{PT2,F2}$, $P_{PT2,GSS1}$, $P_{PT2,GSS2}$, $P_{PT2,GSSF1}$)**
Unit	Pa
Description	Pressure of the gaseous stream in time interval *t*
Measured/calculated/default	Measured

Source of data

Onsite records of the pressure sensors. In the case of temporary situation where Pt malfunctions leading to no readings captured, according to Tool to determine the mass flow of a greenhouse gas in a gaseous stream Version 03.0, data substitution procedure is as follow:

Duration of Missing Data	Data Substitution procedure
Less than six hours	Use the weighted average of the four hours period immediately before and four hours period immediately after the outage
Six to 24 hours	Use the lower bound of 95% confidence interval of the data spanning 24 hours prior to and 24 hours after the outage, whichever results in more conservative estimate of emission reductions
One to seven days	Use the lower bound of 95% confidence interval of the data spanning 72 hours prior to and 72 hours after the outage, whichever results in more conservative estimate of emission reductions
Greater than one week	No data may be substituted

Value(s) of monitored parameter

Average Gauge Pressure (Dates)	**P_t (kPa)**				
	$PT_{PT2,F2}$	**$PT_{PT2,GSS1}$**	**$PT_{PT2,GSS2}$**	**$PT_{PT2,GSS3}$**	**$PT_{PT2,GSSF1}$**
01-07/02/2020	0.00	18.00	0.00	13.59	17.00
08-14/02/2020	0.00	18.00	0.00	16.37	17.00
15-21/02/2020	0.73	17.98	0.00	0.00	16.69
22-29/02/2020	0.87	17.96	0.00	16.56	17.00
01-07/03/2020	0.00	18.00	0.00	18.00	16.91
08-14/03/2020	0.00	18.00	0.00	18.00	16.30
15-21/03/2020	0.00	18.00	0.00	18.00	17.00
22-28/03/2020	0.00	17.97	0.00	17.99	17.00
29-31/03/2020	0.00	18.00	0.00	17.96	17.00
Average	**0.80**	**17.99**	**0.00**	**17.06**	**16.88**

Some of the gauge pressure reading is 0 is due to the shutdown of flares and gas engines.

Average Absolute Pressure (Dates)	**P_t (kPa)**				
	$PT_{PT2,F2}$	**$PT_{PT2,GSS1}$**	**$PT_{PT2,GSS2}$**	**$PT_{PT2,GSS3}$**	**$PT_{PT2,GSSF1}$**
01-07/02/2020	101.33	119.33	101.33	114.91	118.32
08-14/02/2020	101.33	119.33	101.33	117.70	118.33
15-21/02/2020	102.05	119.31	101.33	101.33	118.01
22-29/02/2020	102.20	119.29	101.33	117.88	118.33
01-07/03/2020	101.33	119.32	101.33	119.33	118.24
08-14/03/2020	101.33	119.32	101.33	119.32	117.63
15-21/03/2020	101.33	119.32	101.33	119.33	118.33
22-28/03/2020	101.33	119.30	101.33	119.32	118.33
29-31/03/2020	101.33	119.33	101.33	119.28	118.33
Average	**101.50**	**119.32**	**101.33**	**116.49**	**118.20**

Some of the absolute pressure reading is constant at 101.33, for example, Flare 2, it occurred during the month from 01/02/2020 to 14/02/2020, this is

due to the shutdown of Flare No. 2, there was no result for PT2. The absolute pressure reading is 101.33.

Referring to the Tool to determine the mass flow of a greenhouse gas in a gaseous stream (Version 2.0), page 11, the pressure at normal conditions is 101,325 Pa. The values of the absolute pressure are calculated by adding the ambient pressure at normal conditions to the gauge pressure.

Monitoring equipment

Item	Flare No.2, P_t ($PT_{PT2,F2}$)
	01/02/2020 - 31/03/2020
Type	Rosemount (3051TG1A2B21AB4K5M5)
Accuracy class	± 0.1%
Serial No.	5916057
Calibration frequency	Annually
Date of last calibration	18/09/2019
Validity	1 year

Item	GSS1, P_t ($PT_{PT2,GSS1}$)	
	01/02/2020 - 20/02/2020	21/02/2020 - 31/03/2020
Type	Rosemount (3051TG1A2B21AB4E5Q4) Pressure Transmitter	
Accuracy class	± 0.25%	
Serial No.	5584784	
Calibration frequency	Annually	
Date of last calibration	10/11/2018	21/02/2020
Validity	1 year	

GSS1

PT2 - Due to delay in calibration, the maximum permissible error of ±0.25% which is the equipment accuracy error was applied to PT2 from 01/02/2020 – 20/02/2020 as a conservative approach. The impact of applying this error to the flow normalisation is negligible.

Item	GSS2, P_t ($PT_{PT2,GSS2}$)
	01/02/2020 - 31/03/2020
Type	Autrol (APT3200-G4M11E11S1-M1) Pressure Transmitter
Accuracy class	± 0.075% of span
Serial No.	APT3200-4150998
Calibration frequency	Annually
Date of last calibration	18/09/2019
Validity	1 year

Item	GSS3, P_t ($PT_{PT2,GSS3}$)
	01/02/2020 - 31/03/2020
Type	Endress + Hauser (PMP51-BD21J1KGCGMJA1)
Accuracy class	± 0.1%
Serial No.	N7014C21129
Calibration frequency	Annually

	<table><tr><td>Date of last calibration</td><td>25/07/2018</td></tr><tr><td>Validity</td><td>1 year</td></tr></table> **GSS3** PT2 – Due to delay in calibration, the maximum permissible error of ±0.1% which is the equipment accuracy error was applied to PT2 from 01/02/2020 – 31/03/2020 as a conservative approach. The impact of applying this error to the flow normalisation is negligible. <table><tr><th rowspan="2">Item</th><th>GSSF1, P_t ($PT_{PT2,GSSF1}$)</th></tr><tr><th>01/02/2020 - 31/03/2020</th></tr><tr><td>Type</td><td>Rosemount (3051TG1A2B21AB4E5M5Q4) Pressure Transmitter</td></tr><tr><td>Accuracy class</td><td>± 0.25%</td></tr><tr><td>Serial No.</td><td>02492864</td></tr><tr><td>Calibration frequency</td><td>Annually</td></tr><tr><td>Date of last calibration</td><td>18/09/2019</td></tr><tr><td>Validity</td><td>1 year</td></tr></table>
Measuring/reading/recording frequency	Measured continuously by a pressure transmitter
Calculation method (if applicable)	Instruments with recordable electronic signal (analogical or digital) is used
QA/QC procedures	Periodic calibration against a primary device must be performed periodically and records of calibration procedures must be kept available as well as the primary device and its calibration certificate. Pressure transducers (either capacitive or resistive) must be calibrated monthly
Purpose of data/parameter	Baseline emission calculation
Additional comment	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore, it should be metered only when performing such measurements (with same frequency)

Data / Parameter	**$P_{H2O,t,Sat}$**
Unit	Pa
Description	Saturation pressure of H_2O at temperature T_t in time interval *t*
Measured/calculated/default	Calculated
Source of data	Tool to determine the mass flow of a greenhouse gas in a gaseous stream (Version 03.0)
Value(s) of monitored parameter	**101,325 Pa**
Monitoring equipment	
Measuring/reading/recording frequency	-
Calculation method (if applicable)	This parameter is solely a function of a gaseous stream temperature T_t and can be found at reference [1] for a total pressure equal to 101,325 Pa
QA/QC procedures	-
Purpose of data/parameter	Baseline emissions calculation

Additional comment	[1] Fundamentals of Classical Thermodynamics; Gordon J. Van Wylen, Richard E. Sonntag and Borgnakke; 4º Edition 1994, John Wiley & Sons, Inc.

Data / Parameter	**$V_{CO2,t,db}$**
Unit	m^3 gas CO_2 / m^3 dry gas
Description	Volumetric fraction of greenhouse gas CO_2 in the gaseous stream in time interval *t* on a dry basis
Measured/calculated/default	Measured
Source of data	The V_{CO2} shall be measured manually with portable gas analyser. A minimum sampling frequency of one sample per week to be conducted. As conservative approach, the lower bound of the 95% Confidence Interval will be applied for the data collected.
Value(s) of monitored parameter	0
Monitoring equipment	Portable gas analyser
Measuring/reading/recording frequency	Continuous if not specified in the underlying methodology/tool
Calculation method (if applicable)	Continuous gas analyser operating in dry-basis
QA/QC procedures	Calibration should include zero verification with an inert gas (e.g. N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period
Purpose of data/parameter	Baseline emissions calculation
Additional comment	-

Data / Parameter	**$V_{O2,t,db}$**
Unit	m^3 gas O_2 / m^3 dry gas
Description	Volumetric fraction of greenhouse gas O_2 in the gaseous stream in time interval *t* on a dry basis
Measured/calculated/default	Measured
Source of data	On site measurement
Value(s) of monitored parameter	0.52%
Monitoring equipment	Continuous gas analyser operating in dry-basis
Measuring/reading/recording frequency	Continuous if not specified in the underlying methodology/tool
Calculation method (if applicable)	-
QA/QC procedures	Calibration should include zero verification with an inert gas (e.g. N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period
Purpose of data/parameter	Baseline emissions calculation
Additional comment	-

Data / Parameter	**Status of biogas destruction device**
Unit	-
Description	Operational status of biogas destruction devices
Measured/calculated/default	Measured
Source of data	On-site measurement
Value(s) of monitored parameter	On or Off, refer to $V_{t,wb}$ and operating hour of Gas engines ($\mathbf{Op_{j,h}}$).
Monitoring equipment	Monitoring and documenting may be undertaken by recording the energy production from methane captured or the operation of the flare by means of a flame detector to demonstrate the actual destruction of methane, unless a different method is specified in the underlying methodology/tool. Emission reductions will not accrue for periods in which the destruction device is not operational
Measuring/reading/recording frequency	Continuous if not specified in the underlying methodology/tool
Calculation method (if applicable)	N/A
QA/QC procedures	The operational status will be monitored and cross checked with the amount of gas sent to flare (FT2), and also the operating hour for Gas Engines.
Purpose of data/parameter	Baseline emissions calculation
Additional comment	For flame detector devices, refer to the methodological tool “Project emissions from flaring”

"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 03.0)

Data / Parameter	**$FC_{i,j,y}$**
Unit	ton/yr
Description	Quantity of fuel type i combusted in process j during the year y
Measured/calculated/default	Measured
Source of data	Onsite measurements
Value(s) of monitored parameter	0.01
Monitoring equipment	Fuel meter
Measuring/reading/recording frequency	Continuously
Calculation method (if applicable)	The measurement from the fuel meter is in litre, for the calculation, the amount of diesel in litre will be converted to tonne/year by multiply the density of diesel (kg/l)
QA/QC procedures	The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records
Purpose of data/parameter	Project emissions calculation
Additional comment	-

Data / Parameter	**$EF_{CO2,i,y}$**
Unit	tCO_2/GJ
Description	Weighted average CO_2 emission factor of fuel type i in year y
Measured/calculated/default	Default (Option D was applied in the calculation)
Source of data	Option A will be used if the value is available from the fuel supplier in invoices; Option D will be used if there is no data available from the fuel supplier.
Value(s) of monitored parameter	0.0741
Monitoring equipment	-
Measuring/reading/recording frequency	If the values are provided by the fuel supplier, the measurements should be undertaken in line with national or international fuel standards. If the value is according to IPCC default value, any future revision of the IPCC Guidelines should be taken into account.
Calculation method (if applicable)	For a): The CO_2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	-
Purpose of data/parameter	Project emissions calculation
Additional comment	-

Data / Parameter	**$NCV_{i,y}$**
Unit	GJ/ton
Description	Weighted average net calorific value of fuel type i in year y
Measured/calculated/default	Default (Option D was applied in the calculation)
Source of data	Option A will be used if the value is available from the fuel supplier in invoices; Option D will be used if there is no data available from the fuel supplier.
Value(s) of monitored parameter	43
Monitoring equipment	-
Measuring/reading/recording frequency	For a): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated. For d): Any future revision of the IPCC Guidelines should be taken into account
Calculation method (if applicable)	For a): The NCV emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated. For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	If option A value is used for the calculation, verify if the values under a) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Purpose of data/parameter	Project emissions calculation
Additional comment	-

D.3 Implementation of sampling plan

Not applicable

SECTION E. Calculation of emission reductions or net anthropogenic removals

E.1. Calculation of baseline emissions or baseline net removals

The total baseline emissions according to ACM0001 (Version 18.0) were calculated according to the equations below:

$$BE_y = BE_{CH4,y} + BE_{EC,y} + BE_{HG,y} + BE_{NG,y}$$

BE_y	=	Baseline emissions in year *y* (t CO_2e/yr)
$BE_{CH4,y}$	=	Baseline emissions of methane from the SWDS in year *y* (t CO_2e/yr)
$BE_{EC,y}$	=	Baseline emissions associated with electricity generation in year *y* (t CO_2/yr)
$BE_{HG,y}$	=	Baseline emissions associated with heat generation in year *y* (t CO_2/yr)
$BE_{NG,y}$	=	Baseline emissions associated with natural gas use in year *y* (t CO_2/yr)

$$BE_{CH4} = \left(\left(1 - OX_{top\_layer}\right) \times F_{CH4,PJ,y} - F_{CH,BL,y}\right) \times GWP_{CH4}$$

$BE_{CH4,y}$	=	Baseline emissions of methane from the SWDS in year *y* (t CO_2e/yr)
OX_{top_layer}	=	Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline (dimensionless)
$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (t CH_4/yr)
$F_{CH4,BL,y}$	=	Amount of methane in the LFG that would be flared in the baseline in year *y* (t CH_4/yr)
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

$$F_{CH4,PJ,y} = \eta_{PJ} \times BE_{CH4,SWDS,y}/GWP_{CH4}$$

$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (t CH_4/yr)
$BE_{CH4,SWDS,y}$	=	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* (t CO_2e/yr)
η_{PJ}	=	Efficiency of the LFG capture system that will be installed in the project activity
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

$$BE_{CH4,SWDS,y} = \varphi_y \times (1 - f_y) \times GWP_{CH4} \times (1 - OX) \times \frac{16}{12} \times F \times DOC_{f,y} \times MCF_y \times \sum_{x=1}^{y} \sum_{j} \left(W_{j,x} \times DOC_j \times e^{-k_j \times (y-x)} \times (1 - e^{-k_j}) \right)$$

$BE_{CH4,SWDS,y}$ $PE_{CH4,SWDS,y}$ $LE_{CH4,SWDS,y}$	=	Baseline, project or leakage methane emissions occurring in year *y* generated from waste disposal at a SWDS during a time period ending in year *y* (t CO_2e/yr)
x	=	Years in the time period in which waste is disposed at the SWDS, extending from the first year in the time period (x = 1) to year *y* (x = *y*)
y	=	Year of the crediting period for which methane emissions are calculated (*y* is a consecutive period of 12 months)
$DOC_{f,y}$	=	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year *y* (weight fraction)
$W_{j,x}$	=	Amount of solid waste type *j* disposed or prevented from disposal in the SWDS in the year *x* (t)

$$F_{CH4,flared,y} = F_{CH4,sent\_flare,y} - \frac{PE_{flare,y}}{GWP_{CH4}}$$

$F_{CH4,flared,y}$	=	Amount of methane in the LFG which is destroyed by flaring in year *y* (t CH_4/yr)
$F_{CH4,sent\_flare,y}$	=	Amount of methane in the LFG which is sent to the flare in year *y* (t CH_4/yr)
$PE_{flare,y}$	=	Project emissions from flaring of the residual gas stream in year *y* (t CO_2e/yr)
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

Baseline emissions associated with electricity generation ($BE_{EC,y}$)

$$BE_{EC,y} = \sum_{k} EC_{BL,k,y} \times EF_{EF,k,y} \times (1 + TDL_{k,y})$$

$BE_{EC,y}$	=	Baseline emissions from electricity consumption in year *y* (t CO_2 / yr)
$EC_{BL,k,y}$	=	Quantity of electricity that would be consumed by the baseline electricity consumer *k* in year *y* (MWh/yr)
$EF_{EF,k,y}$	=	Emission factor for electricity generation for source *k* in year *y* (t CO_2/MWh)
$TDL_{k,y}$	=	Average technical transmission and distribution losses for providing electricity to source *k* in year *y*
k	=	Sources of electricity consumption in the baseline

Determination of $BE_{CH4,y}$

Flare No.2

Month	$F_{CH4,flared,y} = F_{CH4,sent\_flare,y} - \frac{PE_{flare,y}}{GWP_{CH4}}$							$F_{CH4,PJ,y} = F_{CH4,flared,y}$	$BE_{CH4} = \left((1 - OX_{top\_layer}) \times F_{CH4,PJ,y} - F_{CH,BL,y}\right) \times GWP_{CH4}$		$BE_y = BE_{CH4,y}$
	Quantity of LFG to Flare No.2 FT2 Flare No.2,y (Nm^3)	Methane average fraction Flare No.2 WCH4	Density of Methane Flare No.2 DCH4 (t/Nm^3)	Amount of methane in LFG sent to Flare No.2 FCH4,sent_flare (t_{CH4})	Project emissions from flaring of residual gas stream PEflare (tCO_2e)	Global Warming Potential Flare No.2 GWPCH4 (tCO_2e/tCH_4)	Amount of methane in LFG destroyed by flaring FCH4,flared (tCH_4)	Amount of methane in LFG flared/used in project activity FCH4, PJ (tCH_4)	Fraction of oxidised methane in LFG in top layer of SWDS in baseline OX_{top_layer}	Baseline emissions of methane from SWDS BE_{CH4} (tCO_2e)	Total Baseline Emission Flare No.2 BE_y (tCO_2e)
01 - 07/02/2020	0.00	0.00	0.0007157	0.00	0.00	25	0.00	0.00	0.10	0.00	0.00
08 - 14/02/2020	0.00	0.00	0.0007157	0.00	0.00	25	0.00	0.00	0.10	0.00	0.00
15 - 21/02/2020	48,882.24	0.64	0.0007157	22.33	61.59	25	19.86	19.86	0.10	446.89	446.89
22 - 29/02/2020	49,829.03	0.62	0.0007157	22.14	55.77	25	19.91	19.91	0.10	448.05	448.05
01 - 07/03/2020	0.00	0.00	0.0007157	0.00	0.00	25	0.00	0.00	0.10	0.00	0.00
08 - 14/03/2020	0.00	0.00	0.0007157	0.00	0.00	25	0.00	0.00	0.10	0.00	0.00
15 - 21/03/2020	0.00	0.00	0.0007157	0.00	0.00	25	0.00	0.00	0.10	0.00	0.00
22 - 28/03/2020	0.00	0.00	0.0007157	0.00	0.00	25	0.00	0.00	0.10	0.00	0.00
29 - 31/03/2020	0.00	0.00	0.0007157	0.00	0.00	25	0.00	0.00	0.10	0.00	0.00

GSS1

Month	$BE_{CH4} = \left(\left(1 - OX_{top\_layer}\right) \times F_{CH4,PJ,y} - F_{CH,BL,y} \right) \times GWP_{CH4}$							
	Density of Methane GSS1 DCH4 (t/Nm3)	Quantity of Landfill Gas Fed into GSS1 FT3 LFG electricity,y (m^3 LFG)	Average methane fraction of the Landfill Gas Fed into GSS1 W_{CH_4}	Amount of methane in LFG used for electricity generation GSS1 $F_{CH4,EL}$ (tCH_4)	Amount of methane in LFG flared/used in project activity GSS1 $F_{CH4,PJ}$ (tCH_4)	Global Warming Potential GSS1 GWP_{CH4} (tCO_2e/tCH_4)	Fraction of oxidised methane in LFG in top layer of SWDS in baseline, GSS1 OX_{top_layer}	Baseline emissions of methane from SWDS GSS1 BE_{CH4} (tCO_2e)
01 - 07/02/2020	0.0007157	180,303.94	0.61	78.99	78.99	25	0.10	1,777.27
08 - 14/02/2020	0.0007157	139,621.62	0.63	62.88	62.88	25	0.10	1,414.71
15 - 21/02/2020	0.0007157	195,828.95	0.64	89.71	89.71	25	0.10	2,018.58
22 - 29/02/2020	0.0007157	210,985.71	0.59	88.67	88.67	25	0.10	1,995.11
01 - 07/03/2020	0.0007157	200,472.51	0.58	83.54	83.54	25	0.10	1,879.70
08 - 14/03/2020	0.0007157	197,354.41	0.58	81.56	81.56	25	0.10	1,835.15
15 - 21/03/2020	0.0007157	205,797.86	0.56	82.91	82.91	25	0.10	1,865.48
22 - 28/03/2020	0.0007157	203,462.34	0.57	83.58	83.58	25	0.10	1,880.62
29 - 31/03/2020	0.0007157	92,419.52	0.57	37.58	37.58	25	0.10	845.46

GSS2

Month	$BE_{CH4} = \left(\left(1 - OX_{top\_layer}\right) \times F_{CH4,PJ,y} - F_{CH,BL,y}\right) \times GWP_{CH4}$							
	Density of Methane GSS2 DCH4 (t/Nm3)	Quantity of Landfill Gas Fed into the GSS2 FT3 LFG electricity,y (m^3 LFG)	Average methane fraction of the Landfill Gas Fed into the GSS2 WCH4	Amount of methane in LFG used for electricity generation GSS2 FCH4,EL (tCH_4)	Amount of methane in LFG flared/used in project activity GSS2 FCH4, PJ (tCH_4)	Global Warming Potential GSS2 GWPCH4 (tCO_2e/tCH_4)	Fraction of oxidised methane in LFG in top layer of SWDS in baseline GSS2 OX_{top_layer}	Baseline emissions of methane from SWDS GSS2 BE_{CH4} (tCO_2e)
01 - 07/02/2020	0.0007157	0.00	0.00	0.00	0.00	25	0.1	0.00
08 - 14/02/2020	0.0007157	0.00	0.00	0.00	0.00	25	0.1	0.00
15 - 21/02/2020	0.0007157	0.00	0.00	0.00	0.00	25	0.1	0.00
22 - 29/02/2020	0.0007157	0.00	0.00	0.00	0.00	25	0.1	0.00
01 - 07/03/2020	0.0007157	0.00	0.00	0.00	0.00	25	0.1	0.00
08 - 14/03/2020	0.0007157	0.00	0.00	0.00	0.00	25	0.1	0.00
15 - 21/03/2020	0.0007157	0.00	0.00	0.00	0.00	25	0.1	0.00
22 - 28/03/2020	0.0007157	0.00	0.00	0.00	0.00	25	0.1	0.00
29 - 31/03/2020	0.0007157	0.00	0.00	0.00	0.00	25	0.1	0.00

GSS3

Month	$BE_{CH4} = \left(\left(1 - OX_{top\_layer}\right) \times F_{CH4,PJ,y} - F_{CH,BL,y} \right) \times GWP_{CH4}$							
	Density of Methane GSS 3 DCH4 (t/Nm3)	Quantity of Landfill Gas Fed into the GSS 3 FT3 LFG electricity,y (m^3 LFG)	Average methane fraction of the Landfill Gas Fed into the GSS 3 WCH4	Amount of methane in LFG used for electricity generation GSS 3 FCH4,EL (tCH_4)	Amount of methane in LFG flared/used in project activity GSS 3 FCH4, PJ (tCH_4)	Global Warming Potential GSS 3 GWPCH4 (tCO_2e/tCH_4)	Fraction of oxidised methane in LFG in top layer of SWDS in baseline GSS 3 OX_{top_layer}	Baseline emissions of methane from SWDS GSS 3 BE_{CH4} (tCO_2e)
01 - 07/02/2020	0.0007157	55,924.73	0.64	25.58	25.58	25	0.1	575.65
08 - 14/02/2020	0.0007157	166,793.72	0.64	76.43	76.43	25	0.1	1,719.67
15 - 21/02/2020	0.0007157	0.00	0.00	0.00	0.00	25	0.1	0.00
22 - 29/02/2020	0.0007157	267,532.15	0.61	116.89	116.89	25	0.1	2,630.05
01 - 07/03/2020	0.0007157	238,758.85	0.61	103.48	103.48	25	0.1	2,328.22
08 - 14/03/2020	0.0007157	346,521.03	0.61	150.25	150.25	25	0.1	3,380.61
15 - 21/03/2020	0.0007157	347,593.83	0.61	151.28	151.28	25	0.1	3,403.70
22 - 28/03/2020	0.0007157	351,498.23	0.61	154.45	154.45	25	0.1	3,475.18
29 - 31/03/2020	0.0007157	143,985.86	0.61	62.97	62.97	25	0.1	1,416.84

GSSF1

$$BE_{CH4} = \left(\left(1 - OX_{top\_layer}\right) \times F_{CH4,PJ,y} - F_{CH,BL,y} \right) \times GWP_{CH4}$$

Month	Density of Methane GSSF1 DCH4 (t/Nm3)	Quantity of Landfill Gas Fed into GSSF1 FT3 LFG electricity,y (m^3 LFG)	Average methane fraction of the Landfill Gas Fed into GSSF1 W_{CH_4}	Amount of methane in LFG used for electricity generation GSSF1 $F_{CH4,EL}$ (tCH_4)	Amount of methane in LFG flared/used in project activity GSSF1 $F_{CH4,PJ}$ (tCH_4)	Global Warming Potential GSSF1 GWP_{CH4} (tCO_2e/tCH_4)	Fraction of oxidised methane in LFG in top layer of SWDS in baseline, GSSF1 OX_{top_layer}	Baseline emissions of methane from SWDS GSSF1 BE_{CH4} (tCO_2e)
01 - 07/02/2020	0.0007157	95,322.81	0.63	43.25	43.25	25	0.10	973.17
08 - 14/02/2020	0.0007157	90,396.93	0.63	40.68	40.68	25	0.10	915.33
15 - 21/02/2020	0.0007157	82,228.03	0.62	36.69	36.69	25	0.10	825.57
22 - 29/02/2020	0.0007157	101,655.01	0.64	46.49	46.49	25	0.10	1,046.08
01 - 07/03/2020	0.0007157	81,409.76	0.63	36.48	36.48	25	0.10	820.79
08 - 14/03/2020	0.0007157	81,527.72	0.65	37.96	37.96	25	0.10	854.16
15 - 21/03/2020	0.0007157	95,580.46	0.64	43.50	43.50	25	0.10	978.67
22 - 28/03/2020	0.0007157	95,515.27	0.65	44.36	44.36	25	0.10	998.15
29 - 31/03/2020	0.0007157	43,173.93	0.65	19.99	19.99	25	0.10	449.80

Determination of $BE_{EC, y}$

GSS1

Month	$BE_{EC,y} = \sum_k EC_{BL,k,y} \times EF_{EF,k,y} \times (1 + TDL_{k,y})$			
	Quantity of electricity generated GSS 1 $EC_{BL,k}$ (MWh)	Emission factor for electricity generation GSS1 $FE_{EL,k}$ (tCO_2/MWh)	Average technical transmission and distribution losses GSS1 TDL_k	Baseline emission for electricity GSS1 $BE_{EC,y}$ (tCO_2)
01 - 07/02/2020	293.05	0.7146	0.0774	225.62
08 - 14/02/2020	248.92	0.7146	0.0774	191.64
15 - 21/02/2020	337.72	0.7146	0.0774	260.01
22 - 29/02/2020	352.79	0.7146	0.0774	271.62
01 - 07/03/2020	304.21	0.7146	0.0774	234.22
08 - 14/03/2020	296.80	0.7146	0.0774	228.51
15 - 21/03/2020	302.08	0.7146	0.0774	232.58
22 - 28/03/2020	297.84	0.7146	0.0774	229.31
29 - 31/03/2020	131.76	0.7146	0.0774	101.44

GSS2 and GSS3

Month	$BE_{EC,y} = \sum_k EC_{BL,k,y} \times EF_{EF,k,y} \times (1 + TDL_{k,y})$			
	Quantity of electricity generated GSS 2 + GSS 3	Emission factor for electricity generation GSS 2 + GSS 3	Average technical transmission and distribution losses GSS 2 + GSS 3	Baseline emission for electricity GSS 2 + GSS 3
	ECBL,k (MWh)	EFEL,k (tCO_2/MWh)	TDLk	$BE_{EC,y}$ (tCO_2)
01 - 07/02/2020	86.13	0.7146	0.0774	66.32
08 - 14/02/2020	292.63	0.7146	0.0774	225.30
15 - 21/02/2020	0.00	0.7146	0.0774	0.00
22 - 29/02/2020	458.26	0.7146	0.0774	352.82
01 - 07/03/2020	400.98	0.7146	0.0774	308.72
08 - 14/03/2020	568.97	0.7146	0.0774	438.06
15 - 21/03/2020	574.90	0.7146	0.0774	442.62
22 - 28/03/2020	572.95	0.7146	0.0774	441.12
29 - 31/03/2020	234.50	0.7146	0.0774	180.55

GSSF1

Month	$BE_{EC,y} = \sum_k EC_{BL,k,y} \times EF_{EF,k,y} \times (1 + TDL_{k,y})$			
	Quantity of electricity generated GSSF1 $EC_{BL,k}$ (MWh)	Emission factor for electricity generation GSSF1 $EF_{EL,k}$ (tCO_2/MWh)	Average technical transmission and distribution losses GSSF1 TDL_k	Baseline emission for electricity GSSF1 $BE_{EC,y}$ (tCO_2)
01 - 07/02/2020	132.36	0.7146	0.0774	101.91
08 - 14/02/2020	129.11	0.7146	0.0774	99.40
15 - 21/02/2020	118.80	0.7146	0.0774	91.47
22 - 29/02/2020	139.03	0.7146	0.0774	107.04
01 - 07/03/2020	97.31	0.7146	0.0774	74.92
08 - 14/03/2020	100.44	0.7146	0.0774	77.33
15 - 21/03/2020	112.71	0.7146	0.0774	86.78
22 - 28/03/2020	112.44	0.7146	0.0774	86.57
29 - 31/03/2020	49.36	0.7146	0.0774	38.00

For this project, the following applies:

1. With reference to ACM0001, Version 18.0, page 21, $EC_{BL,k,y}$ is equivalent to the net amount of electricity generated using LFG in year *y* ($EG_{PJ,y}$). ***$EF_{EL,k,y} = EF_{grid,CM,y}$ and therefore, $BE_{EC,y} = \sum EG_{PJ,y} \times EF_{grid,CM,y} \times (1 + TDL_{k,y})$.***
2. The total electricity generated ($EL_{LFG,y}$) is the amount based on the monthly invoices to the grid operator (Tenaga National Berhad (TNB)) which is also the lower reading from the comparison between (EL4 + EL9 + EL10 + EL12) and (EL5 + EL11 + EL16).

Total Baseline Emissions

$BE_y = BE_{CH4,y} + BE_{EC,y}$

Month	$BE_{CH4,y}$					Total BE_{CH4}	$BE_{EC,y}$			Total BE_{EC}	Total B_{Ey}
	Flare No.2	GSS1	GSS2	GSSF1	GSS3		GSS1	GSSF1	GSS2 + GGS3		
01 - 07/02/2020	0	1,777	0	973	575	3,325	225	101	66	392	3,717
08 - 14/02/2020	0	1,414	0	915	1,719	4,048	191	99	225	515	4,563
15 - 21/02/2020	446	2,018	0	825	0	3,289	260	91	0	351	3,640
22 - 29/02/2020	448	1,995	0	1,046	2,630	6,119	271	107	352	730	6,849
01 - 07/03/2020	0	1,879	0	820	2,328	5,027	234	74	308	616	5,643
08 - 14/03/2020	0	1,835	0	854	3,380	6,069	228	77	438	743	6,812
15 - 21/03/2020	0	1,865	0	978	3,403	6,246	232	86	442	760	7,006
22 - 28/03/2020	0	1,880	0	998	3,475	6,353	229	86	441	756	7,109
29 - 31/03/2020	0	845	0	449	1,416	2,710	101	37	180	318	3,028
Total	**894**	**15,508**	**0**	**7,858**	**18,926**	**43,186**	**1,971**	**758**	**2,452**	**5,181**	**48,367**

Note: The Baseline Emission figure has been rounded down for conservativeness

E.2. Calculation of project emissions or actual net removals

The total project emissions according to ACM0001 (Version 18.0) were estimated according to the equations below:

$$PE_y = PE_{EC,y} + PE_{FC,y} + PE_{DT,y} + PE_{SP,y}$$

PE_y	=	Project emissions in year *y* (t CO_2/yr)
$PE_{EC,y}$	=	Emissions from consumption of electricity due to the project activity in year *y* (t CO_2/yr)
$PE_{FC,y}$	=	Emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation, in year *y* (t CO_2/yr)
$PE_{DT,y}$	=	Emissions from the distribution of compressed/liquefied LFG using trucks, in year *y* (t CO_2/yr)
$PE_{SP,y}$	=	Emissions from the supply of LFG to consumers through a dedicated pipeline, in year *y* (t CO_2/yr)

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EF,j,y} \times (1 + TDL_{j,y})$$

$PE_{EC,y}$	=	Project emissions from electricity consumption in year *y* (t CO_2 / yr)
$EC_{PJ,j,y}$	=	Quantity of electricity consumed by the project electricity consumption source *j* in year *y* (MWh/yr)
$EF_{EF,j,y}$	=	Emission factor for electricity generation for source *j* in year *y* (t CO_2/MWh)
$TDL_{j,y}$	=	Average technical transmission and distribution losses for providing electricity to source *j* in year *y*
j	=	Sources of electricity consumption in the project

Month	Electricity consumed by project activity ELPJ,y (MWh)	Coefficient for grid electricity EF grid,y	Transmission and Distribution Losses TDL,y	Total Project Emission from project activity (tCO2e)
01 - 07/02/2020	41.46	0.7146	0.0774	31.92
08 - 14/02/2020	47.53	0.7146	0.0774	36.59
15 - 21/02/2020	37.62	0.7146	0.0774	28.97
22 - 29/02/2020	67.58	0.7146	0.0774	52.03
01 - 07/03/2020	57.27	0.7146	0.0774	44.09
08 - 14/03/2020	63.17	0.7146	0.0774	48.64
15 - 21/03/2020	64.56	0.7146	0.0774	49.70
22 - 28/03/2020	64.04	0.7146	0.0774	49.31
29 - 31/03/2020	27.49	0.7146	0.0774	21.16

$PE_{FC,j,y}$, for this project, is the emission from diesel backup generators.

Month	Quantity of diesel combusted (Liter)	Diesel Density (kg/l)	Quantity of diesel combusted (t/month)	$COEF_{diesel,y} = NCV_{diesel,j} \times EF_{CO2,diesel,y}$			Total Project Emission from project activity
				Weighted average net calorific value of diesel (GJ/t)	Weighted average CO_2 emission factor of diesel	CO_2 emission coefficient of diesel (tCO_2/mass of volume unit)	
			FC_{diesel}	$NCV_{diesel,j}$	$EF_{CO2,diesel,y}$	$COEF_{diesel,y}$	(tCO2e)
01 - 07/02/2020	0	0.84	0.00	43	0.0741	3.19	0.00
08 - 14/02/2020	4	0.84	0.00	43	0.0741	3.19	0.01
15 - 21/02/2020	0	0.84	0.00	43	0.0741	3.19	0.00
22 - 29/02/2020	0	0.84	0.00	43	0.0741	3.19	0.00
01 - 07/03/2020	0	0.84	0.00	43	0.0741	3.19	0.00
08 - 14/03/2020	3	0.84	0.00	43	0.0741	3.19	0.01
15 - 21/03/2020	0	0.84	0.00	43	0.0741	3.19	0.00
22 - 28/03/2020	0	0.84	0.00	43	0.0741	3.19	0.00
29 - 31/03/2020	0	0.84	0.00	43	0.0741	3.19	0.00

Total Project Emissions

$PE_y = PE_{EC,y} + PE_{FC,y}$

Month	Project Emission from project activity (tCO_2)		Total Project Emission from project activity
	PE_{EC}	PE_{FC}	(tCO2e)
01 - 07/02/2020	31.92	0.00	31.92
08 - 14/02/2020	36.59	0.01	36.60
15 - 21/02/2020	28.97	0.00	28.97
22 - 29/02/2020	52.03	0.00	52.03
01 - 07/03/2020	44.09	0.00	44.09
08 - 14/03/2020	48.64	0.01	48.65
15 - 21/03/2020	49.70	0.00	49.70
22 - 28/03/2020	49.31	0.00	49.31
29 - 31/03/2020	21.16	0.00	21.16

Note: The project emission has been rounded up for conservativeness

E.3. Calculation of leakage emissions

No leakage emissions.

E.4. Calculation of emission reductions or net anthropogenic removals

	Baseline GHG emissions or baseline net GHG removals ($t CO_2e$)	Project GHG emissions or actual net GHG removals ($t CO_2e$)	Leakage GHG emissions ($t CO_2e$)	GHG emission reductions or net anthropogenic GHG removals ($t CO_2e$)		
				Before 01/01/2013	From 01/01/2013	Total amount
Total	48,367	369	0	N/A	47,998	47,998

E.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the registered PDD

Amount achieved during this monitoring period ($t CO_2e$)	Amount estimated ex ante for this monitoring period in the PDD ($t CO_2e$)
47,998	45,010*

E.5.1 Explanation on the calculation of "amount estimated ex ante for this monitoring period in the PDD

Total CER estimated for 2020 (01/01/2020 – 31/12/2020) in PDD version 21.3 is 274,559 tCO_2e, there is 366 days in 2020, as a result, the CER per day for 2020 is 750 tCO_2e, total CER estimated for 01/02/2020 – 31/03/2020 (60 days) is 45,010 tCO_2e.

E.6. Remarks on increase in achieved emission reductions

The total CERs achieved in the 4th monitoring period of 2nd crediting period was 1.1% higher as compared to the value reported in the ex-ante calculations.

The total increase of 1.1% is due to the following reasons:

1. The ex-post average methane concentration is 61.9% which is higher compared to the ex-ante value of 55.45% (as stated in the revised PDD, version 21.3).
2. Gas Engine No.1 has low downtime and have operated in high efficiency (99%)

E.7. Remarks on scale of small-scale project activity

Not applicable.

Appendix 1: Details on the downtime of Flare No.2

Date	Time		Problem Description
	Shut Down	Restart	
1/2/2020	0:00	18/2/2020 16:31	Proper shutdown - to check on gas stability.
20/2/2020	10:13	10:46	Proper shutdown - to swap PT2, GSS1 to Flare 2.
25/2/2020	14:42	29/2/2020 23:59	Proper shutdown - to check on gas stability.
1/3/2020	0:00	31/3/2020 23:59	Proper shutdown - to check on gas stability.

Appendix 2: Details on the downtime of Gas Engine No.1, No.2, No.3, No.4, No.5 and No.6

Gas Engine No.1

Date	Time		Problem Description
	Shut Down	Restart	
20/2/2020	15:27	16:19	Jacket water engine outlet. 3 - way Valve system hang.
21/2/2020	10:31	16:17	Proper shutdown - to check on CT output reading for EL Meter reading.
3/3/2020	18:39	20:38	TNB power surge few seconds. GBS trip.
4/3/2020	11:41	13:05	Jacket water engine outlet.
9/3/2020	09:03	19:45	Proper shutdown for normal service at 1,500 hrs internal by SPE.

Gas Engine No.2

Date	Time		Problem Description
	Shut Down	Restart	
4/2/2020	19:40	21:28	Combustion chamber B7. Change with spare unit.
6/2/2020	09:22	12/2/2020 13:31	Proper shutdown HT Pump leaking, SPE to repair.
20/2/2020	10:11	11:24	Proper shutdown - to swap PT2 , GSS1 to Flare 2.
23/2/2020	09:45	13:43	Combustion chamber B7.
23/2/2020	23:22	24/2/2020 06:45	Combustion chamber B7.
24/2/2020	12:37	12:57	Safety Chain H116 Ext. quick stop with heat removal.
	20:16	20:49	Safety Chain H116 Ext. quick stop with heat removal.
25/2/2020	06:03	10:36	Main Fault. ACB breaker failure.
2/3/2020	16:29	16:47	Combustion chamber A6.
3/3/2020	18:21	18:40	TNB power surge few seconds. GBS trip.
	20:29	21:08	Proper shutdown to reset GSS 1 blower # 1.
9/3/2020	01:17	07:50	H116 EXT. quick stop with heat removal safety chain.
10/3/2020	09:21	09:24	Combustion Chamber A1, B3 & A5.
11/3/2020	04:23	07:10	H116 EXT. quick stop with heat removal safety chain.
	10:21	10:36	Combustion Chamber A1 & B6.
	14:30	14:50	Power surge few seconds.
18/3/2020	09:39	15:59	Proper shutdown for normal service at 1,500 hrs internal by SPE.
23/3/2020	15:16	15:44	Combustion Chamber A6. Clean spark plug.
25/3/2020	01:13	01:58	Gas pressure gas control system. Motor blower # 1 jammed.
	07:44	13:23	Proper shutdown to normalize GSS 1 blower.

Gas Engine No.3

Date	Time		Problem Description
	Shut Down	Restart	
2/2/2020	06:46	12:05	Combustion chamber A7 & A8. Clean spark plug.
5/2/2020	11:46	12:08	Combustion Chamber A7.
	22:52	22:58	Combustion Chamber A7.
6/2/2020	11:02	13:18	Combustion Chamber A7.
10/2/2020	00:57	07:29	Combustion Chamber A3.
12/2/2020	13:47	14:46	Receiver temperature high.
14/2/2020	07:53	08:01	Combustion chamber A7. Clean spark plug.
17/2/2020	14:40	14:48	Combustion chamber B1. Clean spark plug.
18/2/2020	06:03	07:43	Combustion chamber A1 & B4.
	23:53	19/2/2020 09:07	Combustion chamber B1.
20/2/2020	10:11	10:58	Proper shutdown - to swap PT2, GSS1 to Flare 2.
	14:57	15:36	Combustion chamber B4. Clean spark plug.
21/2/2020	12:54	13:04	Jacket water engine outlet.
22/2/2020	03:27	03:46	Combustion chamber B1.
	04:38	07:30	Combustion chamber B1. Change new spark plug.
24/2/2020	09:17	17:13	Proper shutdown for normal service at 1,500 hrs interval by SPE.
25/2/2020	06:03	12:44	Mains fault. ACB breaker failure.
	21:04	12:11	A3 Critical faulty. Check engine.
27/2/2020	10:23	10:48	Combustion chamber B4.
28/2/2020	13:19	14:36	Jacket water engine outlet.
2/3/2020	10:56	14:35	Combustion chamber A2 & B4. Clean spark plug.
3/3/2020	18:47	21:02	TNB power surge few seconds. GBS trip.
4/3/2020	01:11	07:28	Gen CB trip. Reset
10/3/2020	09:24	09:28	Combustion Chamber A1, A4 & B6.
11/3/2020	14:30	14:53	Power surge few seconds.
23/3/2020	15:21	15:48	Combustion Chamber A4 & A5. Cleaned spark plug.
25/3/2020	01:20	08:19	Gas pressure gas control system. Motor blower # 1 jammed.
25/3/2020	13:07	13:19	Proper shutdown to install new motor blower from GSS 2.
26/3/2020	14:46	15:05	Combustion chamber A3. Clean spark plug.
26/3/2020	16:11	16:20	Combustion chamber A2. Change new spark plug.
26/3/2020	20:49	21:31	Combustion chamber B6. Clean spark plug.
29/3/2020	14:17	14:28	Combustion chamber A1.
31/3/2020	17:23	17:32	Combustion chamber A6. Clean spark plug.

Gas Engine No.4

Date	Time		Problem Description
	Shut Down	Restart	
1/2/2020	00:00	29/2/2020 23:59	- Major Overhaul works at 22364 hours by MPS.
1/3/2020	00:00	31/3/2020 23:59	- Major Overhaul works at 22364 hours by MPS.

Gas Engine No.5

Date	Time		Problem Description
	Shut Down	Restart	
1/2/2020	00:00	6/2/2020 12:59	Generator protection, Rocoff fault. Communication fail.
8/2/2020	06:54	16:38	Deriation power control, Throttle valve B faulty. SPE change spare unit.
10/2/2020	17:06	17:34	Gas pressure gas control system.
12/2/2020	11:17	24/2/2020 13:20	TNB power failure. Sime Darby PPU trip, at differential relay.
5/3/2020	09:08	16:01	Proper shutdown for normal service at 1,500 hrs internal by SPE.
11/3/2020	13:55	14:19	Power surge few seconds.
12/3/2020	17:49	18:09	Combustion chamber A2. Cleaned spark plug.
23/3/2020	14:32	14:46	Lightning surge, CH4 GSS 3 trip.
28/3/2020	14:07	14:18	Deriation Power control.
30/3/2020	23:15	23:47	Engine speed. Deriation power control.
31/3/2020	16:44	17:12	Power surge few seconds.

Gas Engine No.6

Date	Time		Problem Description
	Shut Down	Restart	
1/2/2020	00:00	6/2/2020 13:08	Generator protection, Rocoff fault. Communication fail.
10/2/2020	17:06	17:38	Gas pressure gas control system.
11/2/2020	08:54	17:59	Proper shutdown - for normal service at 1,500 hrs internal by SPE.
12/2/2020	11:17	24/2/2020 13:26	TNB power failure. Sime Darby PPU trip, at differential relay.
2/3/2020	21:02	3/3/2020 07:46	Combustion chamber A1, A2 & B1. Clean spark plug.
3/3/2020	11:47	3/3/2020 23:00	Power control deriation. After inspection found that drum at Gas mixer loose.
11/3/2020	13:55	14:23	Power surge few seconds.
21/3/2020	19:23	19:54	Combustion chamber B1. Cleaned spark plug.
23/3/2020	14:32	14:43	Lightning surge, CH4 GSS 3 trip
31/3/2020	16:44	17:09	Power surge few seconds.

Appendix 3: Description on the calculation applied in ER Calculation Sheet for Tool to determine the mass flow of a greenhouse gas in a gaseous stream, version 03.0

Referring to the tools, for LFG temperatures below 60 ºC, moisture could be neglected due to its very low influence on final results and thus, the measurement in wet or dry basis is not important (as reflected in the amendments to ACM 0001, version 9.1 onwards). In the case where the LFG temperature exceeds 60ºC, the same basis for both methane concentration and flow measurement will be considered according to the tools.

There are 6 measurement options as tabulated below:

Option	Flow of gaseous stream	Volumetric fraction
A	Volume flow – dry basis	dry or wet basis[3]
B	Volume flow – wet basis	dry basis
C	Volume flow – wet basis	wet basis
D	Mass flow – dry basis	dry or wet basis
E	Mass flow – wet basis	dry basis
F	Mass flow – wet basis	wet basis

During this monitoring period, for Flare No.2 with LFG temperature exceeding 60ºC, option B measurement was selected and was applied in the CER calculation.

Determination of the absolute humidity of the gaseous stream

The absolute humidity is a parameter required for Option B. It can be determined from the measurement of moisture content (Option 1) or by assuming the gaseous stream is dry or saturated in a simplified conservative approach (Option 2).

Option 2 which assumes that the gaseous stream is dry or saturated in a simplified conservative approach was selected for the CER calculation.

Option 2: Simplified calculation without measurement of the moisture content

This option provides a simple and conservative approach to determine the absolute humidity by assuming the gaseous stream is dry or saturated depending on which is the conservative situation. If it is conservative to assume that the gaseous stream is dry, then $m_{H2O,t,db}$ is assumed to equal to 0. If it is conservative to assume that the gaseous stream is saturated, then $m_{H2O,t,db}$ is assumed to be equal to the saturation absolute humidity ($m_{H2O,t,db,sat}$) and is calculated using the equation below:

$$m_{H2O,t,db,Sat} = \frac{p_{H2O,t,Sat} \times MM_{H2O}}{(P_t - p_{H2O,t,Sat}) \times MM_{t,db}}$$

Where:

$m_{H2O,t,db,sat}$	=	Saturation absolute humidity in time interval *t* on a dry basis (kg H_2O/kg dry gas)
$p_{H2O,t,Sat}$	=	Saturation pressure of H_2O at temperature T_t in time interval *t* (Pa)
T_t	=	Temperature of the gaseous stream in time interval *t* (K)
P_t	=	Absolute pressure of the gaseous stream in time interval *t* (Pa)
MM_{H2O}	=	Molecular mass of H_2O (kg H_2O/kmol H_2O)
$MM_{t,db}$	=	Molecular mass of the gaseous stream in a time interval *t* on a dry basis (kg dry gas/kmol dry gas)

Parameter	Formula / description
$p_{H20,t,Sat}$	<table><tr><td>1</td><td>2</td><td></td></tr><tr><td>Filonenko/ Ginzburg (1973) and Filonenko et al. (1971)</td><td>0…100</td><td>$p_s = \exp(6.416 + 17.3 \cdot t / (238+t))$,</td></tr></table> P_s – Saturation pressure of H_2O t – LFG Temperature
P_t	**Absolute Pressure** $P_a = P_g + P_{at}$ $P_a = P_g + 101325$ where, P_a = Absolute Pressure, P_g = Gauge Pressure, P_{at} = Atmospheric Pressure.
MM_{H2O}	18.0152 kg/kmol Default value from the tool
$MM_{t,db}$	$$MM_{t,db} = \sum_k (v_{k,t,db} * MM_k)$$ Where: $MM_{t,db}$ = Molecular mass of the gaseous stream in time interval *t* on a dry basis (kg dry gas/kmol dry gas) $v_{k,t,db}$ = Volumetric fraction of gas *k* in the gaseous stream in time interval *t* on a dry basis (m^3 gas k/m^3 dry gas) MM_k = Molecular mass of gas *k* (kg/kmol) k = All gases, except H_2O, contained in the gaseous stream (e.g. N_2, CO_2, O2, CO, H2, CH_4, N_2O, NO, NO2, SO_2, SF_6 and PFCs). See available simplification below Default value for $MM_{i,k}$, Gases involve in the calculation are CH_4, CO_2, and O_2

Parameter	Formula / description

Data / Parameter:	MM_i
Data unit:	kg/kmol
Description:	Molecular mass of greenhouse gas *i*
Value to be applied:	

Compound	Structure	Molecular mass (kg / kmol)
Carbon dioxide	CO_2	44.01
Methane	CH_4	16.04
Nitrous oxide	N_2O	44.02
Sulfur hexafluoride	SF_6	146.06
Perfluoromethane	CF_4	88.00
Perfluoroethane	C_2F_6	138.01
Perfluoropropane	C_3F_8	188.02
Perfluorobutane	C_4F_{10}	238.03
Perfluorocyclobutane	c-C_4F_8	200.03
Perfluoropentane	C_5F_{12}	288.03
Perfluorohexane	C_6F_{14}	338.04

Any comment:	

Data / Parameter:	MM_k
Data unit:	kg/kmol
Description:	Molecular mass of gas *k*
Value to be applied:	For gases *k* that are greenhouse gases appy values for MM_i.

Compound	Structure	Molecular mass (kg / kmol)
Nitrogen	N_2	28.01
Oxygen	O_2	32.00
Carbon monoxide	CO	28.01
Hydrogen	H_2	2.02
Nitric oxide	NO	30.01
Nitrogen dioxide	NO_2	46.01
Sulfur dioxide	SO_2	64.06

Any comment:	

Option B of measurement options

The volumetric flow of the gaseous stream in time interval *t* on a dry basis ($V_{t,db}$) is determined by converting the measured volumetric flow from wet basis to dry basis as follows:

$$V_{t,tb} = V_{t,wb}/(1 + v_{H2O,t,db})$$

Where:

$V_{t,db}$ = Volumetric flow of the gaseous stream in time interval *t* on a dry basis (m³ dry gas/h)

$V_{t,wb}$ = Volumetric flow of the gaseous stream in time interval *t* on a wet basis (m³ wet gas/h)

$v_{H2O,t,db}$ = Volumetric fraction of H_2O in the gaseous stream in time interval *t* on a dry basis (m³ H_2O/m³ dry gas)

The volumetric fraction of H_2O in time interval *t* on a dry basis ($v_{H2O,t,db}$) is estimated according to the equation below:

$$v_{H2O,t,db} = \frac{m_{H2O,t,db} * MM_{t,db}}{MM_{H2O}}$$

Where:

$v_{H2O,t,db}$ = Volumetric fraction of H_2O in the gaseous stream in time interval *t* on a dry basis (m^3 H_2O/m^3 dry gas)

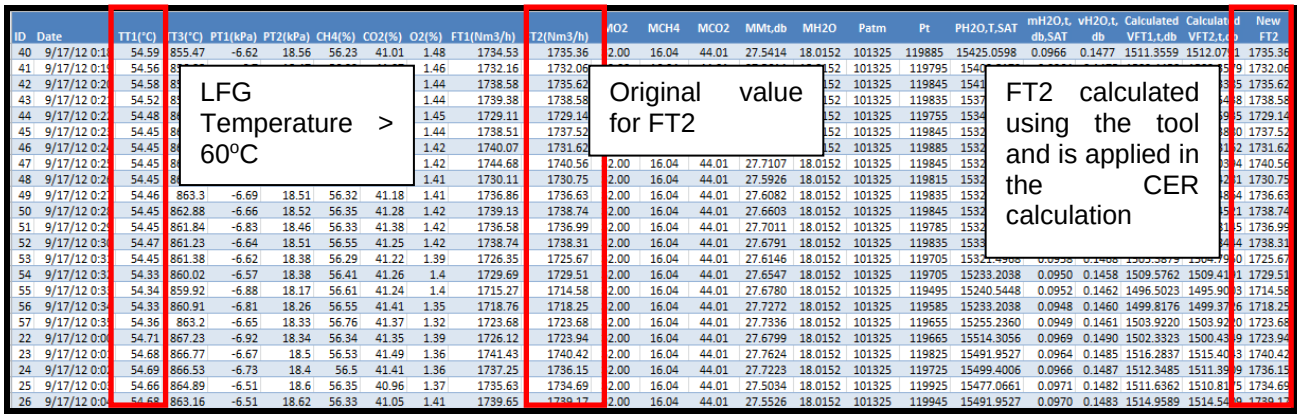
$m_{H2O,t,db}$ = Absolute humidity in the gaseous stream in time interval *t* on a dry basis (kg H_2O/kg dry gas)

$MM_{t,db}$ = Molecular mass of the gaseous stream in time interval *t* on a dry basis (kg dry gas/kmol dry gas)

MM_{H2O} = Molecular mass of H_2O (kg H_2O/kmol H_2O)

The absolute humidity of the gaseous stream ($m_{H2O,t,db}$) is determined using Option 2 above ($MM_{t,db}$) which is as demonstrated above.

Example of the calculation using the *Tool to determine the mass flow of a greenhouse gas in a gaseous stream*, version 03.0.



ID	Date	TT1(°C)	TT3(°C)	PT1(kPa)	PT2(kPa)	CH4(%)	CO2(%)	O2(%)	FT1(Nm3/h)	T2(Nm3/h)	MO2	MCH4	MCO2	MMt,db	MH2O	Patm	Pt	PH2O,T,SAT	mH2O,t,db,SAT	vH2O,t,db	Calculated VFT1,t,db	Calculated VFT2,t,db	New FT2
40	9/17/12 0:1	54.59	855.47	-6.62	18.56	56.23	41.01	1.48	1734.53	1735.36	2.00	16.04	44.01	27.5414	18.0152	101325	119885	15425.0598	0.0966	0.1477	1511.3559	1512.07	1735.36
41	9/17/12 0:1	54.56	8					1.46	1732.16	1732.06					52	101325	119795	154					1732.06
42	9/17/12 0:2	54.58	8					1.44	1738.58	1735.62					52	101325	119845	154					1735.62
43	9/17/12 0:2	54.52	8					1.44	1739.38	1738.58					52	101325	119835	153					1738.58
44	9/17/12 0:2	54.48	8					1.45	1729.11	1729.14					52	101325	119755	153					1729.14
45	9/17/12 0:2	54.45	8					1.44	1738.51	1737.52					52	101325	119845	153					1737.52
46	9/17/12 0:2	54.45	8					1.42	1740.07	1731.62					52	101325	119885	153					1731.62
47	9/17/12 0:2	54.45	8					1.42	1744.68	1740.56	2.00	16.04	44.01	27.7107	18.0152	101325	119845	153					1740.56
48	9/17/12 0:2	54.45	8					1.41	1730.11	1730.75	2.00	16.04	44.01	27.5926	18.0152	101325	119815	153					1730.75
49	9/17/12 0:2	54.46	863.3	-6.69	18.51	56.32	41.18	1.41	1736.86	1736.63	2.00	16.04	44.01	27.6082	18.0152	101325	119835	153					1736.63
50	9/17/12 0:2	54.45	862.88	-6.66	18.52	56.35	41.28	1.42	1739.13	1738.74	2.00	16.04	44.01	27.6603	18.0152	101325	119845	153					1738.74
51	9/17/12 0:2	54.45	861.84	-6.83	18.46	56.33	41.38	1.42	1736.58	1736.99	2.00	16.04	44.01	27.7011	18.0152	101325	119785	153					1736.99
52	9/17/12 0:3	54.47	861.23	-6.64	18.51	56.55	41.25	1.42	1738.74	1738.31	2.00	16.04	44.01	27.6791	18.0152	101325	119835	153					1738.31
53	9/17/12 0:3	54.45	861.38	-6.62	18.38	56.29	41.22	1.39	1726.35	1725.67	2.00	16.04	44.01	27.6146	18.0152	101325	119705	153					1725.67
54	9/17/12 0:3	54.33	860.02	-6.57	18.38	56.41	41.26	1.4	1729.69	1729.51	2.00	16.04	44.01	27.6547	18.0152	101325	119705	15233.2038	0.0950	0.1458	1509.5762	1509.41	1729.51
55	9/17/12 0:3	54.34	859.92	-6.88	18.17	56.61	41.24	1.4	1715.27	1714.58	2.00	16.04	44.01	27.6780	18.0152	101325	119495	15240.5448	0.0952	0.1462	1496.5023	1495.90	1714.58
56	9/17/12 0:3	54.33	860.91	-6.81	18.26	56.55	41.41	1.35	1718.76	1718.25	2.00	16.04	44.01	27.7272	18.0152	101325	119585	15233.2038	0.0948	0.1460	1499.8176	1499.37	1718.25
57	9/17/12 0:3	54.36	863.2	-6.65	18.33	56.76	41.37	1.32	1723.68	1723.68	2.00	16.04	44.01	27.7336	18.0152	101325	119655	15255.2360	0.0949	0.1461	1503.9220	1503.92	1723.68
22	9/17/12 0:0	54.71	867.23	-6.92	18.34	56.34	41.35	1.39	1726.12	1723.94	2.00	16.04	44.01	27.6799	18.0152	101325	119665	15514.3056	0.0969	0.1490	1502.3323	1500.43	1723.94
23	9/17/12 0:0	54.68	866.77	-6.67	18.5	56.53	41.49	1.36	1741.43	1740.42	2.00	16.04	44.01	27.7624	18.0152	101325	119825	15491.9527	0.0964	0.1485	1516.2837	1515.40	1740.42
24	9/17/12 0:0	54.69	866.53	-6.73	18.4	56.5	41.41	1.36	1737.25	1736.15	2.00	16.04	44.01	27.7223	18.0152	101325	119725	15499.4006	0.0966	0.1487	1512.3485	1511.39	1736.15
25	9/17/12 0:0	54.66	864.89	-6.51	18.6	56.35	40.96	1.37	1735.63	1734.69	2.00	16.04	44.01	27.5034	18.0152	101325	119925	15477.0661	0.0971	0.1482	1511.6362	1510.81	1734.69
26	9/17/12 0:0	54.68	863.16	-6.51	18.62	56.33	41.05	1.41	1739.65	1739.17	2.00	16.04	44.01	27.5526	18.0152	101325	119945	15491.9527	0.0970	0.1483	1514.9589	1514.54	1739.17

Document information

Version	*Date*	*Description*
07.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Add a section on remarks on the observance of the scale limit of small-scale project activity during the crediting period; • Add "changes specific to afforestation or reforestation project activity" as a possible post-registration changes; • Clarify the reporting of net anthropogenic GHG removals for A/R project activities between two commitment periods; • Make editorial improvements.
06.0	7 June 2017	Revision to: • Ensure consistency with version 01.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Make editorial improvements.
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.
04.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB 70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01.0	28 May 2010	EB 54, Annex 34. Initial adoption.

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